Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

TECHNOLOGY DEPARTMENT

PUBLIC LIBRARY
AUG 31 1949
DETROIT

XYLONITE Regd for endurance

B.X. PLASTICS LTD. *Head Sales Office:* HIGHAM STATION AVENUE, LONDON E.4 *Larkswood 4491*

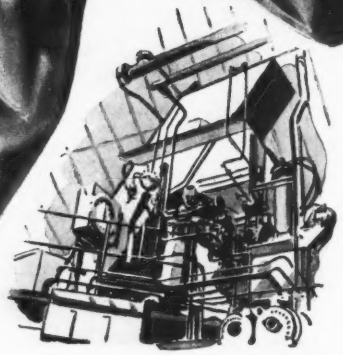
BX Leaders in Thermo Plastics

R v.14 Aug. - Dec. 1949

Craylene

GIVES ALL THE EFFECTS

WITHOUT THE DEFECTS



Craylene *Matt finish* means a wider market because many women object to the characteristic over-glossiness of ordinary P.V.C. The greater *Strength* of Craylene means long life for garments and goodwill for you. Craylene retains all the virtues of P.V.C.—the ease with which it can be cleaned with soap and water—its low absorption of moisture. We shall be happy to render you encouraging co-operation in developing new lines in

MATT FINISH

***EXTRA STRONG* CRAYLENE**

VINYL SHEETING

THE GREENWICH LEATHERCLOTH CO. LTD · Durex Works · St. Mary Cray · Kent *Ravensbourne 4674*

Tech.

in Full Colour Range

FULLY FLEXIBLE • FLYWEIGHT
WEATHERPROOF • HIGHLY DURABLE
NON-FURRING • ACID & OIL RESISTING
SUPPLIED IN STANDARD LENGTHS

Ideal for GARDEN HOSE • CAR WASHING
PLATING SHOPS • AIRLINES • PETROL
FEED PIPES • LUBRICATION OIL PIPES, *Etc.*

by Melwood Thermoplastics Limited

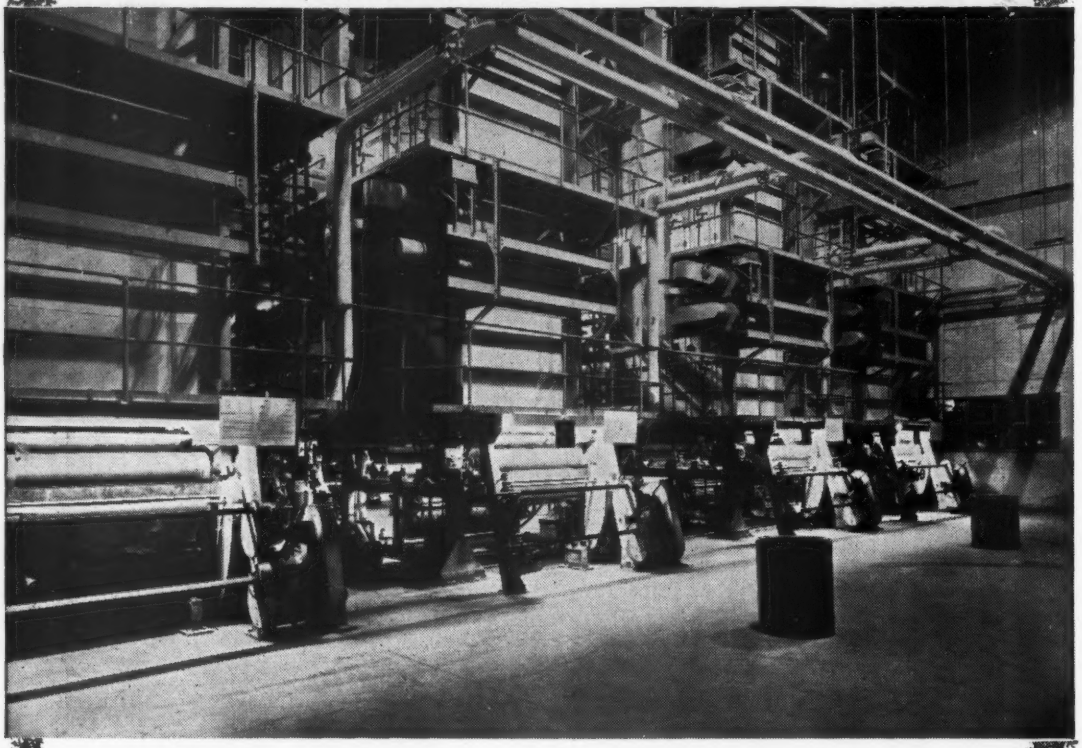
38, CHEAPSIDE, LUTON, BEDFORDSHIRE
TELEPHONE LUTON 4759
LONDON OFFICE: 49, LONDON WALL, E.C.2. Telephone: MONARCH 6862/3

Greater efficiency needs this lighting!

To speed up work, reduce mistakes, increase efficiency all round, install OSRAM fluorescent lamps and G.E.C. fittings. They combine greater light output and cool burning, with shadowless glare-free illumination.

If fluorescent lighting is already installed, remember that old lamps can be expensive to operate because the light output fades long before they burn out. Some of your old lamps which have been in use for several years may not be giving full value for current consumed. Replace them with OSRAM fluorescent lamps. ★

Here's an example of good lighting. It is available now for all industries.



Osram FLUORESCENT LIGHTING with G.E.C. Fittings

★ **G.E.C. illuminating engineers will gladly check your lighting. Expert advice freely available for new installations.**

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Geon 121

PVC paste resin...

simplifies cloth coating

● British Geon's new paste resin, Geon 121, is PVC in a different physical form. Mix with plasticizer, add colour, and a free-flowing paste is ready to apply direct on to cloth, simply by spreading. A single pass . . . a few minutes under heat . . . through the embossing rolls . . . and the product is finished! Leathercloth and other coated cloths equal in quality to the finest products of conventional calendering techniques can be produced in this way from Geon · 121, quickly, easily and economically. Write or telephone British Geon for Technical Bulletin No. G.4 ; a sample will also be supplied on request.

Other uses of Geon 121 :—

In addition to leathercloth and other coated cloths, Geon 121 paste resin can be used to produce coatings and films of all thicknesses. It may be applied as a thin-walled dielectric coating on conductors used in multi-core telephone cable, or as protective coatings on industrial equipment such as coils or plating racks.

Cloth coating with Geon 121 requires only inexpensive spreading equipment.

Geon
Polyvinyl Materials

GEON 101 . . Polyvinyl chloride resin.
GEON 200 series . . Vinyl copolymer resins.
GEON 121 Paste Resin . . Vinyl paste resin.
GEON Compounds & Pastes . . Based on Geon resins.
GEON 15X Latex . . Modified vinyl latex.
GEON 31X Latex . . Air-drying vinyl latex.
GEON Polyblend . . Geon/Hycar blend.
GEON Polyblend Latex . . Geon/Hycar latex blend.
Hycar OR 15 & 25 synthetic rubbers and latices.

BRITISH GEON LIMITED, *Sales & Technical Service :* **21 St. James's Square, London, S.W.1.** *Whitehall 9561.*

New Automatic Press Welder

REDIFON
TYPE JP.3

The new Redifon JP3 Welder is a fully automatic press welder capable of welding sheet P.V.C. articles up to a size of 18″ by 14″ in a single operation. No technical skill is required as operators are employed solely on loading and unloading the sliding trays and can be trained to obtain maximum quantity production of plastic toys, bags, wallets and similar articles almost immediately.
Telephone VANdyke 5691 for a demonstration or write for full details including price and delivery.

Redifon HEATING

INDUSTRIAL ELECTRONICS DIVISION

REDIFON LIMITED
BROOMHILL ROAD, WANDSWORTH, LONDON, S.W.18

Designers and Manufacturers of Industrial Electronic and Radio Communication Equipment

RH3

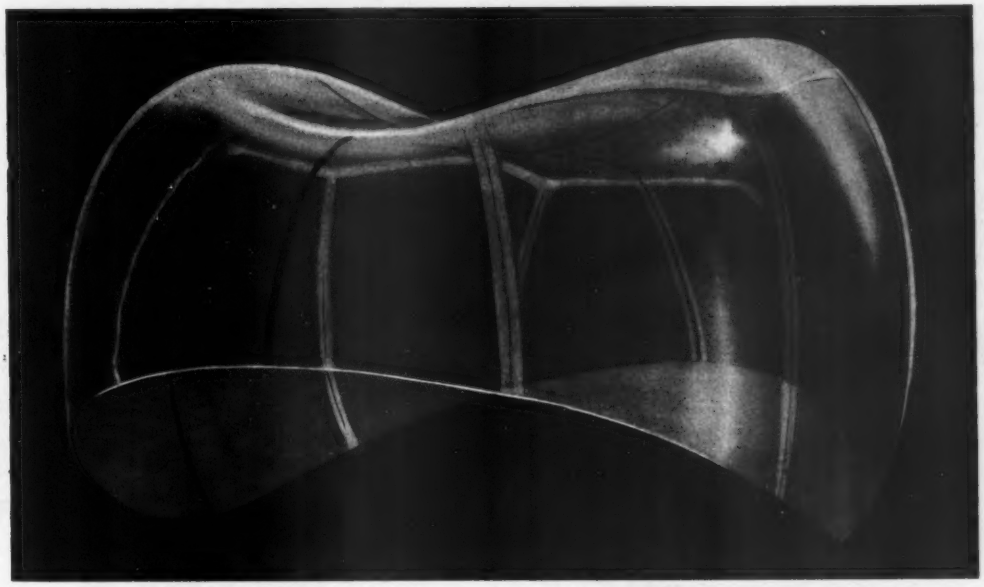
WE ARE

THE MANUFACTURERS OF THE
LARGEST AND MOST COMPLICATED

PLASTIC COMPONENTS

FOR AIRCRAFT AND OTHER INDUSTRIES

CAN *WE ASSIST YOU?*

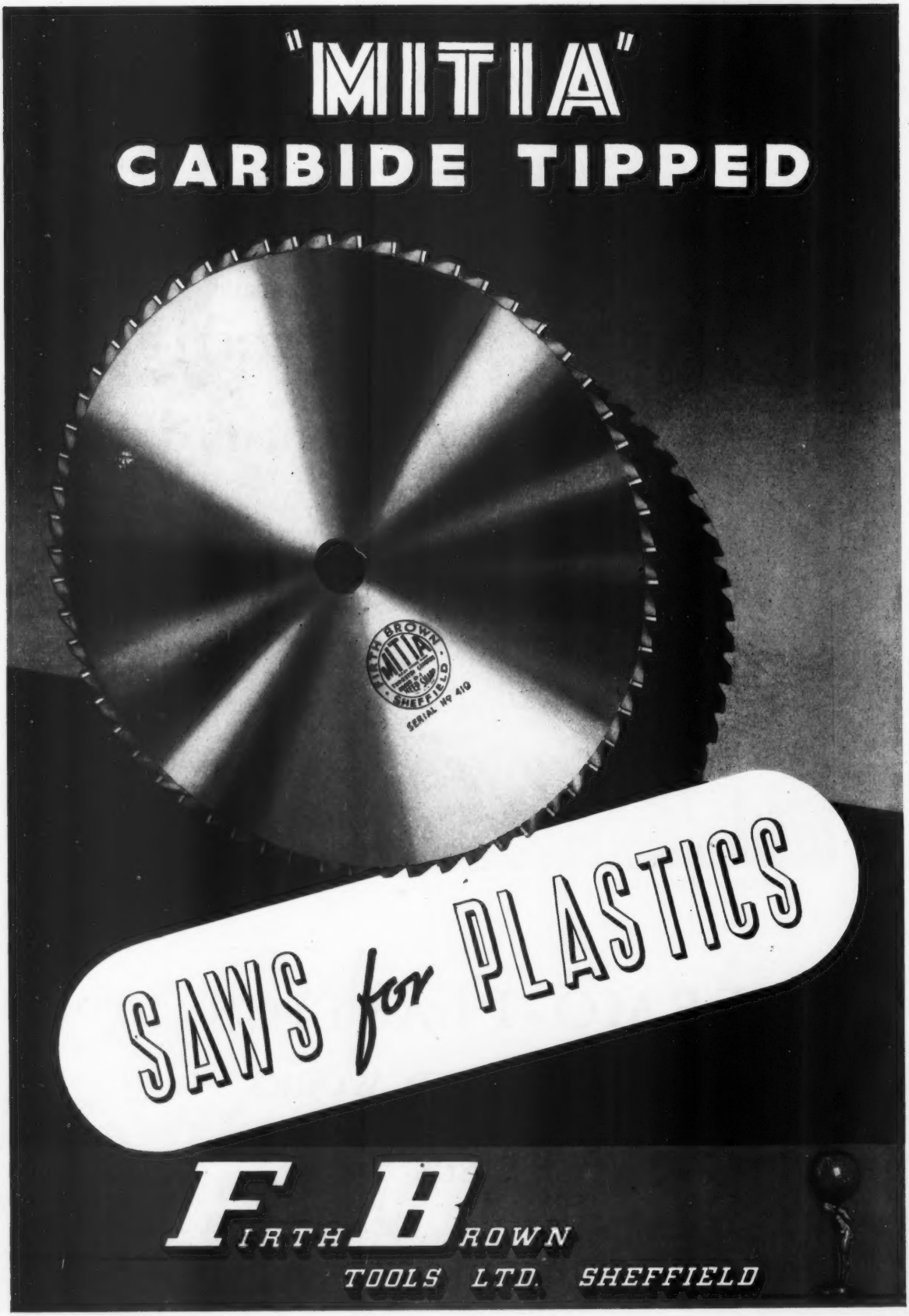


RADOME FOR 'LINCOLN' AIRCRAFT. OVERALL DIMENSIONS 9' 6" x 6' 6" x 3' 3".

THERMO-PLASTICS LTD

LUTON ROAD WORKS
DUNSTABLE
BEDS

'Phone: DUNS. 686-7-8. Telegrams: THERMO-PLASTICS, DUNSTABLE


"MITIA"
CARBIDE TIPPED
SAWS for PLASTICS
F B
FIRTH BROWN
TOOLS LTD. SHEFFIELD

INSPECTORS DEPEND ON LORIVAL

for a spot-on job and no rejects

In factories which have left it to Lorival inspectors have been heard to sigh for the good old days when they had something to reject . . . For Lorival's moulding service—in plastics or ebonite—is founded on precision. A Lorival job is a spot-on job—and a punctual job into the bargain.

The Lorival service is a complete service. It can take in everything from the original design-work onwards. It is there to take the whole load of moulding problems off your shoulders. Just call in Lorival and watch the inspectors get bored.

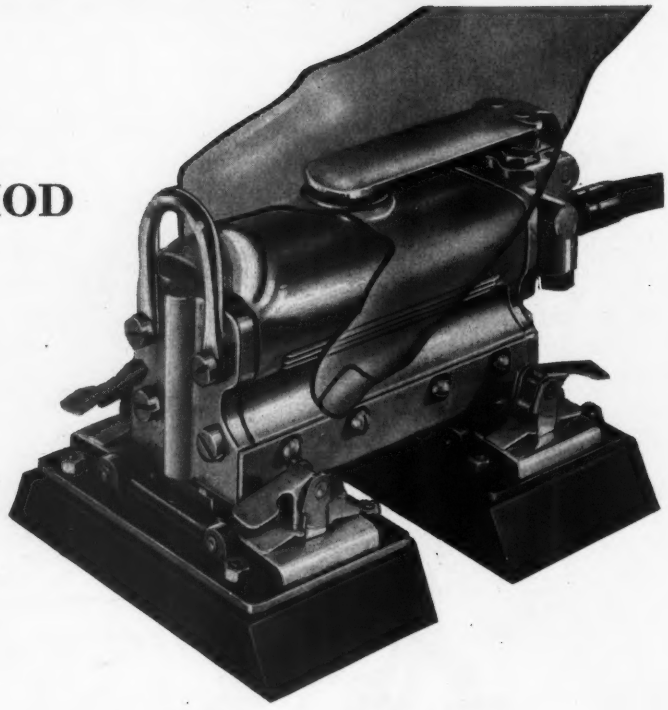
L13

LORIVAL PLASTICS

UNITED EBONITE & LORIVAL LTD., LITTLE LEVER, NEAR BOLTON, LANCS.

SUNDSTRAND *Pneumatic* SANDER

THE MODERN MACHINE METHOD for SANDING or SURFACE PREPARATION FOR *ANY* FINAL FINISH



FOR a beautiful finish, use the SUNDSTRAND pneumatic SANDER.

Portable, light and easy to use, it will speed up output and reduce operating costs. It is completely free from vibration. It can be used in awkward places and on flat, convex or concave surfaces. The pads reciprocate in opposite directions, thus eliminating end-thrust "travel."

The Sundstrand can be used for either wet or dry sanding. It is automatically lubricated, and interchangeable pads for various needs are available when sanding or finishing wood, metal, plastic and composition materials.

Write for details and demonstration to Dept. P/1.

SUNDSTRAND PNEUMATIC SANDERS (BRITAIN) LTD.
NORGREN WORKS, SHIPSTON-ON-STOUR, WARWICKSHIRE. Tel. 110
KENT HOUSE, 87 REGENT STREET, LONDON, W.1. Tel. REGent 2951

NOTE

Our New L.M.P. 90 mm. Twin Screw ***EXTRUSION MACHINE*** *will be featured in the September issue of this Journal.*

PERFORMANCE & LOW COST PRODUCTION

The Pioneers of Plastic Injection Moulding Machines have again achieved another success with the new S.H. 16/20. This heavy duty machine is capable of producing articles up to 20 ounce weight in a variety of materials, and incorporates several new features.

Other sizes also in production are S.H. 12/16, 16 ounce, and S.H. 24/28, 28 ounce.

May we send you full details of this machine or arrange for a demonstration ?

PLASTIC MACHINES

[redacted]

Phone **MONarch 8722** *Grams* **TECHNIMACH FINSQUARE LONDON** *Cables* **TECHNIMACH LONDON**

B

To obtain world-wide uniformity it has been decided to change the brand name of Esso Nitrile Rubber to PARACRIL.

The four grades of this super rubber remain entirely unchanged in specification.

PARACRIL 18–80 **PARACRIL 26 NS 60**

PARACRIL 26 NS 90 **PARACRIL 35 NS 90**

It pays to say ESSO **PARACRIL**

NITRILE RUBBER

(Formerly Perbunan)

ANGLO - AMERICAN OIL COMPANY LIMITED

Tygan REGD

IS UNEQUALLED FOR DURABILITY

Tygan is probably the nearest approach to an everlasting fabric which has yet been devised. Its resilience, toughness and abrasion resistance ensure excellent wearing qualities, where treatment is particularly severe. Water will not rot or weaken it; damp will not cause it to mould; sun will not fade it; and moth will not attack it. Tygan is also exceptionally resistant to acids, alkalis, alcohol and other organic solvents, and possesses outstanding weathering properties.

Tygan can be cleaned with a damp cloth

Tygan is available in a wide range of attractive colours and designs. It upholsters well, and because it can easily be cleaned by sponging, it keeps its smart appearance.

Tygan is produced by Fothergill & Harvey Ltd. This is an assurance of the highest attainable quality and serviceability, which conform in every respect to the best standards of Lancashire woven productions.

Tygan is woven from BEXAN, a synthetic yarn developed by B.X. Plastics Ltd.

Tygan stands up to the daily grind

This is one of the advertisements appearing for Tygan in the furnishing trade press

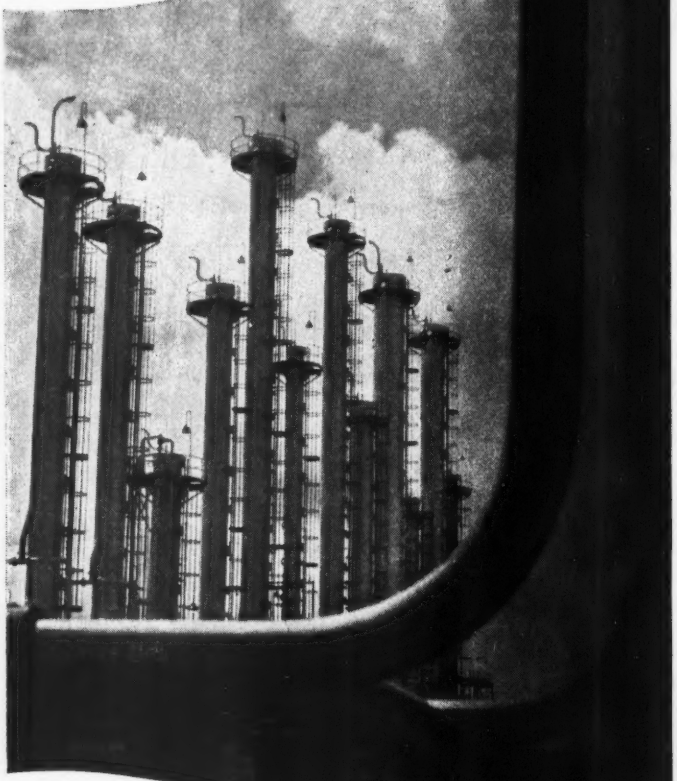
Write for illustrated folder

including patterns, quoting reference z.8, to FOTHERGILL & HARVEY LTD. Harvester House, Peter St., Manchester 2

c

For a new asset to production

It is no exaggeration to describe the new Shell chemical plant at Stanlow, Cheshire, as a great asset to Britain's economy and industry. Here, essential products such as industrial solvents and chemical intermediates can now be produced from petroleum brought from sterling sources, thus saving millions of dollars on alternative raw materials. In addition to earning further foreign exchange, a full and steady supply of these essential chemicals is henceforward assured to British industries here at home—chemicals of exceptional purity and absolute consistency. For this new proof of British enterprise



thank Shell Chemicals

SHELL

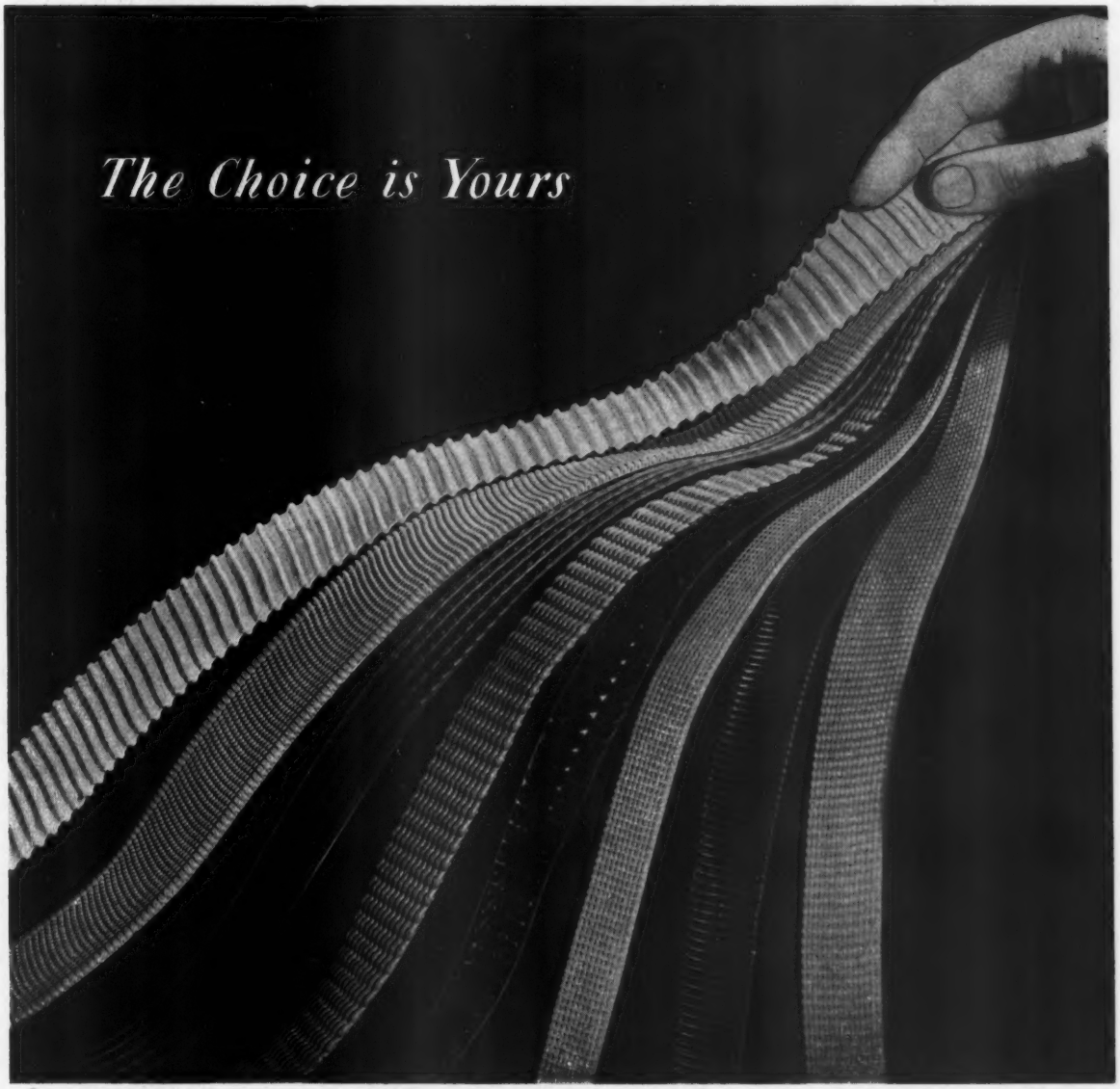
The initial range of chemicals to be produced at Shell's new plant include:

ACETONE
METHYL ETHYL KETONE
METHYL ISOBUTYL KETONE
MESITYL OXIDE
DIACETONE ALCOHOL
ISOPROPYL ALCOHOL
SECONDARY BUTYL ALCOHOL
ISOPROPYL ETHER

Durastrip

In a variety of artistic colours and novel designs for ladies' and gentlemen's belts, etc.

Also available in two-colour direct extrusions (not colour printed) and in clear, transparent material



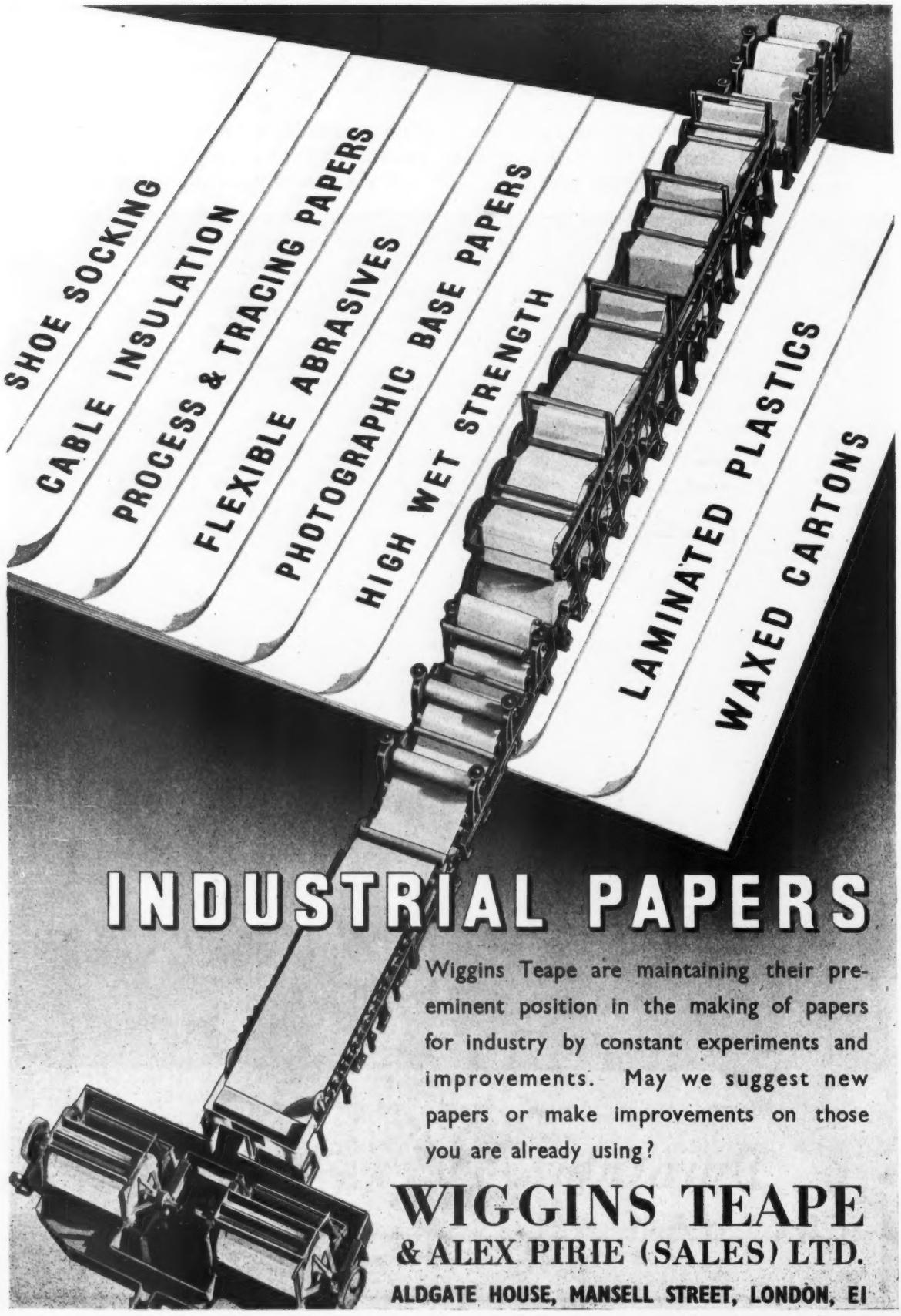
Sole Manufacturers :

Duratube & Wire Ltd

FELTHAM **MIDDLESEX**

DURAWIRES DURACABLES Reg. Trade Mark

Telephone : Feltham 3332, 3803 & 2891



INDUSTRIAL PAPERS

Wiggins Teape are maintaining their pre-eminent position in the making of papers for industry by constant experiments and improvements. May we suggest new papers or make improvements on those you are already using?

WIGGINS TEAPE
& ALEX PIRIE (SALES) LTD.

ALDGATE HOUSE, MANSELL STREET, LONDON, E1

MONSANTO'S CHLORINATED DIPHENYLS

Aroclors

are compatible with these thermoplastic and rubbery materials:

- Chlorinated rubber
- Ethyl cellulose
- Benzyl cellulose
- Cellulose Aceto-butyrate
- Cellulose nitrate
- Alkyd resins
- Shellac
- Ester gum
- Rosin
- Polystyrene
- Polyvinyl acetate
- Polyvinyl chloride/acetate
- Polyisobutylene
- Asphalt
- Rubber
- Styrene-butadiene copolymers
- Drying oils
- Waxes

in combination with which they are successfully used in these applications:

- Lacquers
- Pressure sensitive adhesives
- Heat sensitive adhesives
- Hot melts
- Glues
- Pigment grinding vehicles
- Paints
- Printing inks
- Varnishes
- Paper coatings
- Wood sealers

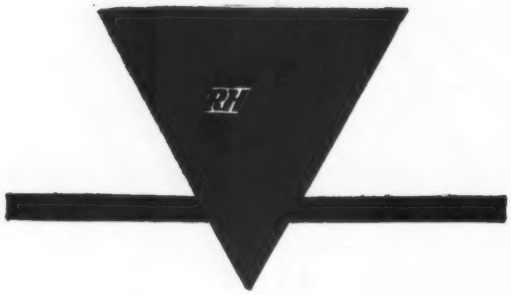
because the Aroclors impart these properties:

moisture-vapour proofness, adhesion, acid and alkali resistance, reduced burning rate, improved electrical insulating properties, heat sealing properties and mould and bacterial resistance

Write to Plastics Department for Technical Sales Bulletin G.2.,

MONSANTO CHEMICALS LIMITED
VICTORIA STATION HOUSE · LONDON · SWI

D



STYRON

Polystyrene Moulding Granules

manufactured by

DOW CHEMICAL OF CANADA LTD.

The **RIGHT** Plastic
for injection, compression and extrusion
in a full range of standard colours, and

NEW IMPROVED CRYSTAL

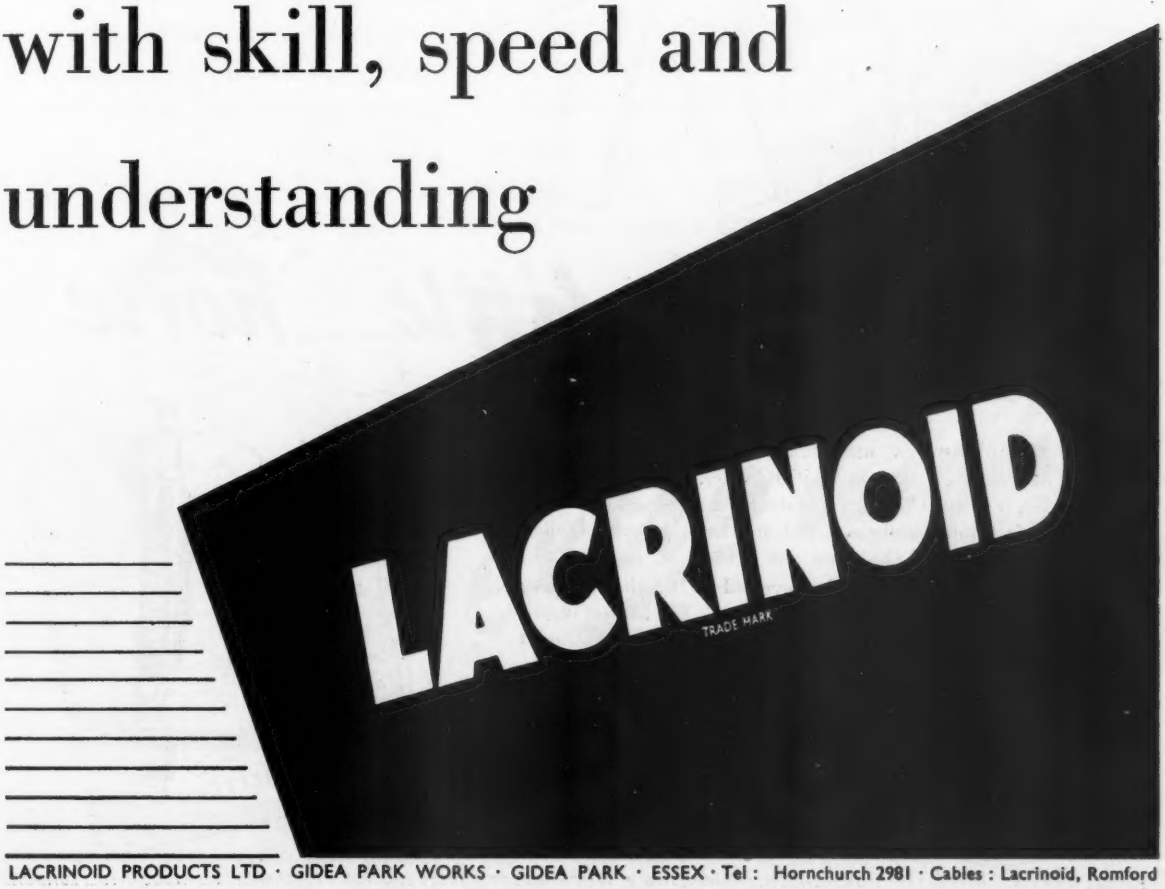
●

R. H. COLE AND COMPANY LIMITED

2, CAXTON STREET, WESTMINSTER, S.W.1

Phone : Whitehall 0711/2/3 and 7193/4 Grams : Geratole, Phone, London

When it is a matter of moulding and fabrication of plastics, Lacrinoid can do the job with skill, speed and understanding



LACRINOID PRODUCTS LTD · GIDEA PARK WORKS · GIDEA PARK · ESSEX · Tel: Hornchurch 2981 · Cables: Lacrinoid, Romford

E

DETROIT PUBLIC LIBRARY

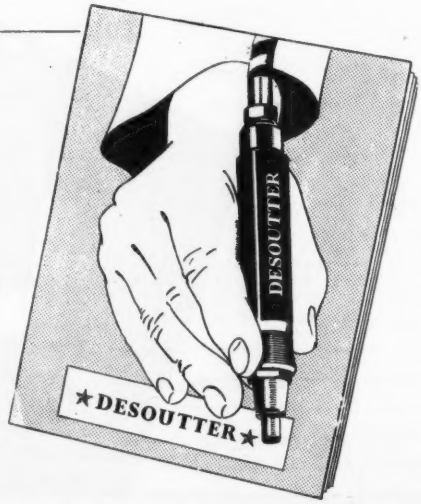
We Proudly Present

the latest, the loveliest, the teeniest weeniest, our own, our very own Baby Power Screwdriver—M.60. Not much bigger than a fountain pen but what a bundle of energy! There's going to be a great rush to be godfather to little M.60 and we shall give preference to electrical engineers, watchmakers, chaps now working overtime in optics or indeed anyone who will give him the sort of work he loves. We'll send you a leaflet about M.60 if you like. And then perhaps you too will be a godfather. Goody goody!

Call up the little TEENY-WEENY horse

THE DESOUTTER MINIATURE SCREWDRIVER weighs 8 ounces. Size: 5½″ long by ⅞″ diameter. Capacity: Screws, No. 3 to 10 BA, and equivalent nuts. Operation: The air is automatically switched on when the tool is applied to the head of the screw and pressed on to the work. The tool can quickly be reversed by turning the ring switch fitted in the head of the tool. The impact clutch of new design gives perfect torque selection when used with pressure regulator on the air line.

Write for literature giving much more information.



DESOUTTER

Specialists in Lightweight Pneumatic and Electric Portable Tools.

DESOUTTER BROS. LIMITED, THE HYDE, HENDON, LONDON, N.W.9. TELEPHONE: COLINDALE 6346-7-8-9. TELEGRAMS: DESPNUCO, HYDE, LONDON.

CRC 201

Look at the difference!

There's a much bigger difference than you might perhaps think between 'high' and 'extra high' when you're considering shock resistance in phenolic moulding materials. 'Extra' means as much as three times greater strength! Here are the figures: the impact strength of ordinary high shock-resisting phenolic material is 0.9 ft./lbs. But Rockite 3932 *extra* high shock-resisting has an impact strength of 2.7 ft./lbs. Rockite 3932 is one of the strongest grades of phenolic moulding materials produced in this country. It is the inevitable selection for moulding trays, table tops, textile accessories, instrument cases, tool handles and all moulded articles liable to dropping, knocking, vibration or general hard handling during use. Ask BRP for a sample and full particulars of Rockite 3932.

ROCKITE 3932 is

extra high

SHOCK-RESISTING

PHENOLIC MOULDING MATERIAL

BRITISH RESIN PRODUCTS LTD., 21 St. James's Square, London, S.W.1
Telephone: Whitehall 8021 (7 lines). *"Rockite" is a Registered Trade Mark*

BRP

New & Secondhand
PLANT & MACHINERY
Prompt delivery
SUBJECT TO PRIOR SALE

Page 600

PLASTIC MOULDING PLANT

Two 100-ton downstroke presses by DANIELS. 12-in. diam. rams, 14-in. stroke, 4 columns, electric platens 20-in. sq., daylight 14-in. Fitted with independent hydraulic ejectors.

Unused 100-ton downstroke press by DANIELS, new 1948. 12-in. diam. ram, 16-in. stroke, 4 columns, electric platens 20-in. sq., daylight 20-in. Complete with Cambridge temperature control and Towler "Electraulic" pumping equipment.

100-ton downstroke press by DANIELS. 12-in. diam. ram, 14-in. stroke, 4 columns, electric platens 20-in. sq., daylight 14-in.

Several 80-ton upstroke presses by BRADLEY AND TURTON. 10-in. diam. ram, 12-in. stroke, 4 columns, electric platens 18-in. × 17-in., daylight 12-in./16-in. adjustable. Fitted with side pushback rams and thermostats.

75-ton downstroke press by BRADLEY AND TURTON. 10-in. diam. ram, 13-in. stroke, 4 columns, electric platens 17-in. sq., daylight 16-in. Thermostatic control and Towler "Electraulic" pumping equipment.

Two 75-ton downstroke presses by DANIELS. 10-in. diam. ram, 14-in. stroke, 4 columns, electric platens 14-in. sq., daylight 14-in. Independent hydraulic ejector.

75-ton upstroke press by DAVID BRIDGE. 10-in. diam. ram, 10-in. stroke, 2 columns, electric platens 18-in. × 16-in., daylight 10-in. Thermostatic control.

70-ton downstroke press by JOHN SHAW. 10-in. diam. ram, 11-in. stroke, 4 columns, electric platens 16¾-in. × 14-in., daylight 11-in. Independent hydraulic ejector.

Several 25-ton dual units by FINNEY, each comprising 2 downstroke presses with 6-in. diam. rams and choice of electric or steam-heated platens. Complete with pumping equipment motorized 400/440/3/50.

Rotary cutter, size 16-in. diam. × 27-in., by BALL AND JEWELL, U.S.A. Five rotary and 6 stationary knives, ⅝-in. diam. screen and feed hopper. Direct coupled to 65 h.p. L.D.M. slipring motor 415/3/50 with starter.

Mono radial pump, type FV 57, 14 g.p.m. at 400 lb. sq. in., and 2¼ g.p.m. at 3,500 lb. sq. in. Motorized 400/3/50.

Variable stroke pump by BRADLEY AND TURTON, type 4L/1M, max. output 6 g.p.m., max. pressure 1 ton sq. in. Self-contained weight-loaded accumulator and 5 h.p. motor 400/3/50.

Two swashplate pumps by FAWCETT PRESTON, automatic two-stage type, max. low pressure output 50 g.p.m., max. high pressure 2,240 lb. sq. in. Direct driven by vert. spindle motors 400/3/50.

NEW ELECTRIC MOTORS

Immediate delivery from stock

The following all continuously rated, wound for 400/440/3/50 speeds, 1,500 r.p.m., synchronous.

Totally enclosed types—

BROOK : 2 h.p., 3 h.p., 4 h.p., 6 h.p., 15 h.p.

BULL : 1½ h.p., 2 h.p., 3 h.p., 4 h.p., 5 h.p., 6 h.p., 9 h.p., 12 h.p., 14 h.p.

Protected types—

BROOK : 1½ h.p., 4 h.p.

BULL : 3 h.p.

High-speed motors, 3,000 r.p.m., synchronous—

BROOK : 2 h.p., protected type, cont. rated 220/440/3/50.

BULL : 2½ h.p., T/E. cont. rated 400/440/3/50.

ALPHA HARRIS tropically rated motors, enclosed ventilated type, 1 h.p. and 2 h.p. for 210 V. single-phase supply, also 1 h.p., 2 h.p., 4½ h.p., 7½ h.p., 10 h.p., 12½ h.p., 15 h.p., 20 h.p., 25 h.p. and 30 h.p. for 400/440/3/50, speeds 1,500 r.p.m., synchronous.

ALPHA HARRIS 220 V. D.C. tropically rated motors, enclosed ventilated 3 h.p. and 5 h.p., 7½ h.p., also 110 V. D.C. 5 h.p., all 1,500 r.p.m.

Whatever Plant you need turn to
GEORGE COHEN
SONS & COMPANY LIMITED
WOOD LANE, LONDON, W.12. *Telephone: Shepherds Bush 2070 Telegrams: Omniplant, Chisk, London*
STANNINGLEY, Near LEEDS *Telephone: Pudsey 2241 Telegrams: Coborn, Leeds*
And at SHEFFIELD · BIRMINGHAM · NEWCASTLE-ON-TYNE · SOUTHAMPTON · GLASGOW · DUNFERMLINE · SWANSEA · MANCHESTER · BATH · BELFAST · BRUSSELS
ONE OF THE 600 GROUP OF COMPANIES
P/497/G75

In mesh

with today's requirements for the

RADIO INDUSTRY

Mouldings and moulding powders. Resins solid, powdered or in solution. Insulating varnishes. Cements and lacquers. Anti-friction resins for fabric bearings. Casting resins. Capping cements. Paint resins. Filling compounds. Sealing fluids.

Full information and data from Sales Development Department
BIRKBYS LTD., LIVERSEDGE, YORKSHIRE, ENGLAND
London Office: 79, Baker Street, W.1

The Chemical Resistance

OF MONSANTO Lustrex

POLYSTYRENE MOULDING CRYSTALS

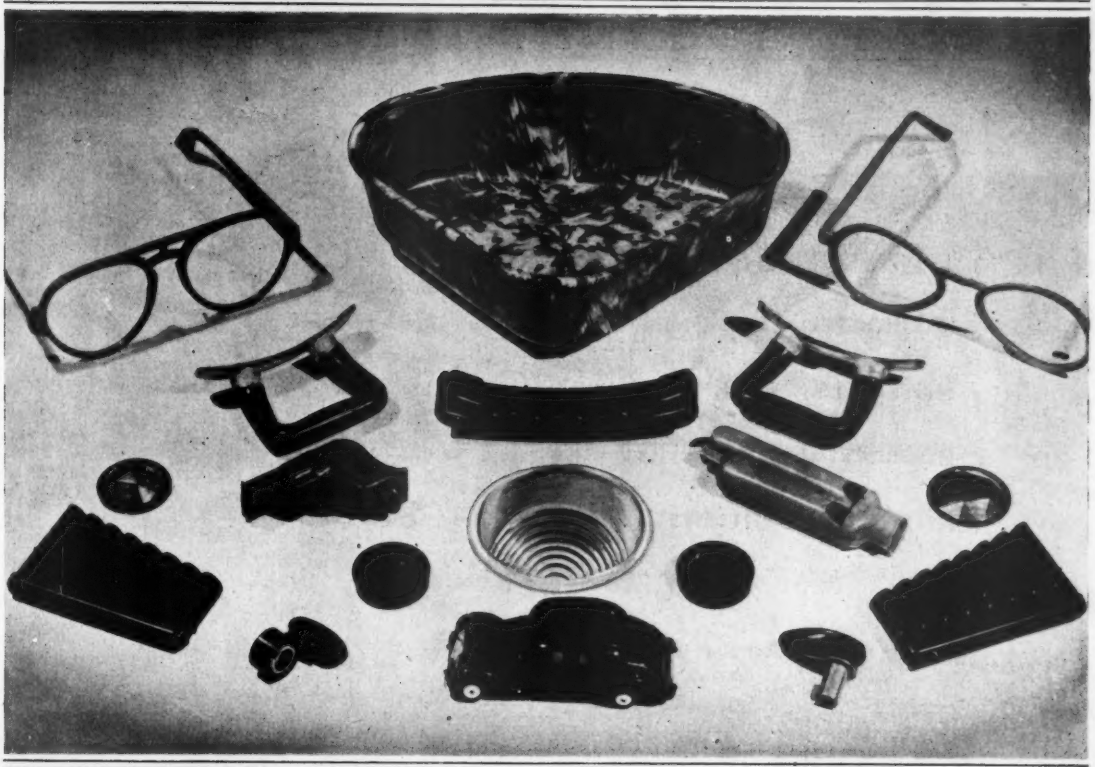
One of the characteristics of Lustrex is strong chemical resistance. Acids, alkalis, and alcohols do not affect it. The acid resistance of Lustrex enables its use in parts where metals would be attacked. Even hydrofluoric acid, which attacks glass, has no deleterious effect on Lustrex. Its chemical resistance to various substances is shown in the table below

WATER	unaffected
ALKALIS	unaffected
ESSENTIAL OILS	surface and colour affected by some
ALIPHATIC HYDROCARBONS	unaffected
ACIDS	unaffected
ALCOHOLS	unaffected
AROMATIC HYDROCARBONS	soluble
CHLORINATED HYDROCARBONS	soluble

QUICK FACTS ABOUT LUSTREX . . . Low cost per pound . . . Lightweight . . . Faster moulding . . . New brilliance and clarity . . . No taste or odour . . . High dimensional stability . . . Good chemical resistance . . . Excellent electrical qualities . . . Gay colour range.

Write to Plastics Department, **MONSANTO CHEMICALS LIMITED**
VICTORIA STATION HOUSE · LONDON · S.W.1

MOULDS



by

UNIVERSAL TOOLS LTD.

TRAMWAY PATH, MITCHAM, SURREY.

Telephone: MITCHAM 1624, 1625, 1626

G

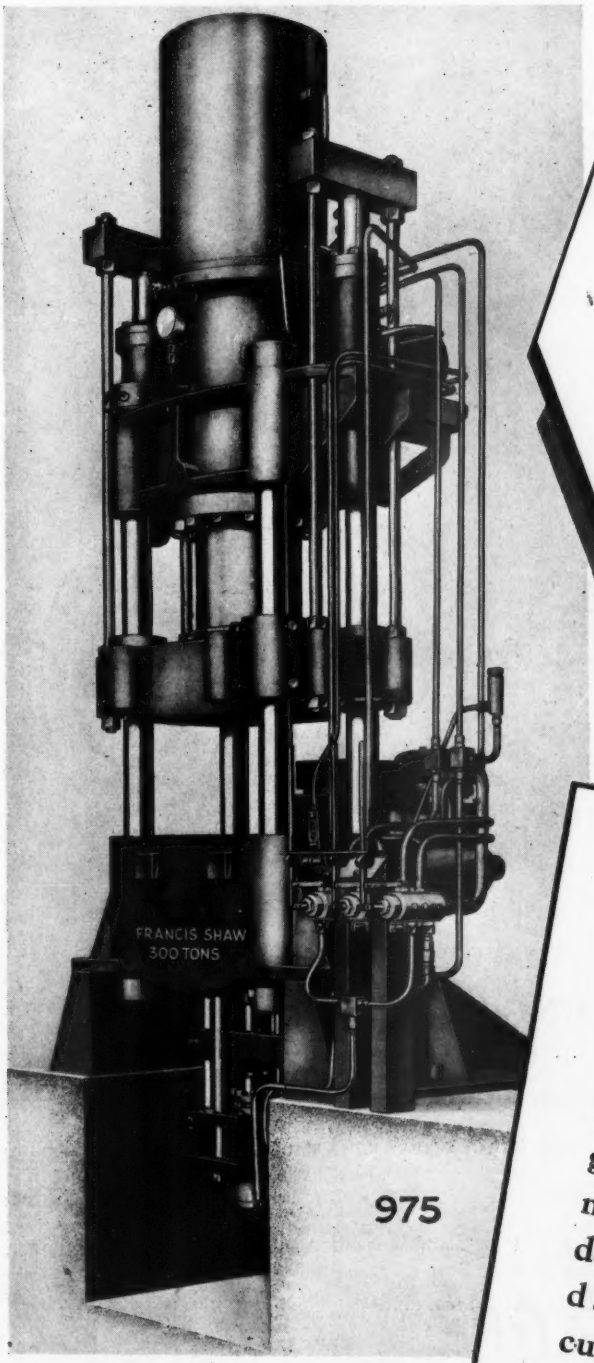
Crystalate Activities

THE ACTIVITIES OF THE CRYSTALATE GROUP OF COMPANIES EMBRACE THE APPLICATIONS FOR ALL TRADES OF MOULDED PLASTICS (BY COMPRESSION, TRANSFER AND INJECTION); FABRICATED, MACHINED AND STAMPED PLASTIC LAMINATED MATERIALS; LAMINATED PAPER AND FABRIC BASE TUBES, BOBBINS AND FORMERS; MICANITE TUBES; MICA, MICANITE AND PRESSPAHN INSULATIONS; BAR COVERING; CAPSTAN LATHE PRODUCTION; FABRICATION AND MOULDING OF "PERSPEX" (Acrylic Sheet); MOULD, TOOL AND JIG MAKING AND PRINTING.

CRYSTALATE

Crystalate Ltd., Golden Green, Tonbridge, Kent. *Phone: Hadlow 233/4/5 (20 lines)*

PLASTIC MOULDERS, FABRICATORS & TOOL MAKERS SINCE 1899



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We illustrate a 300-tons downstroke self-contained press with mould closing ram at the rear and equipped with bottom ejector gear. This is one of the many presses we have designed outside our standard range to suit customers' requirements

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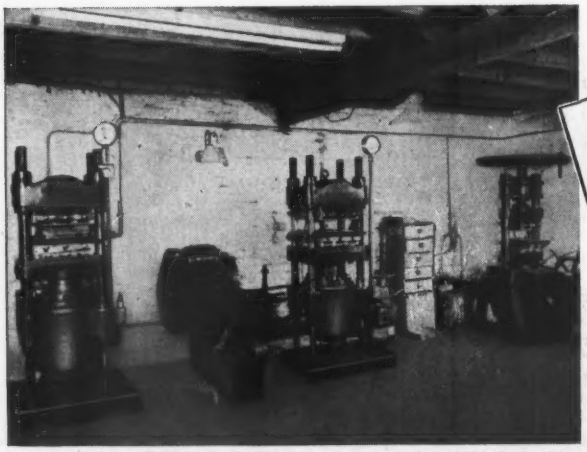

Some of the gas-heated Bradley & Turton compression presses recently installed by The Insulation Manufacturing Co. of Glastonbury for the production of plastic industrial mouldings.

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Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

PROPRIETORS : TEMPLE PRESS LIMITED

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EDITOR : M. D. CURWEN, B.Sc., A.R.I.C.

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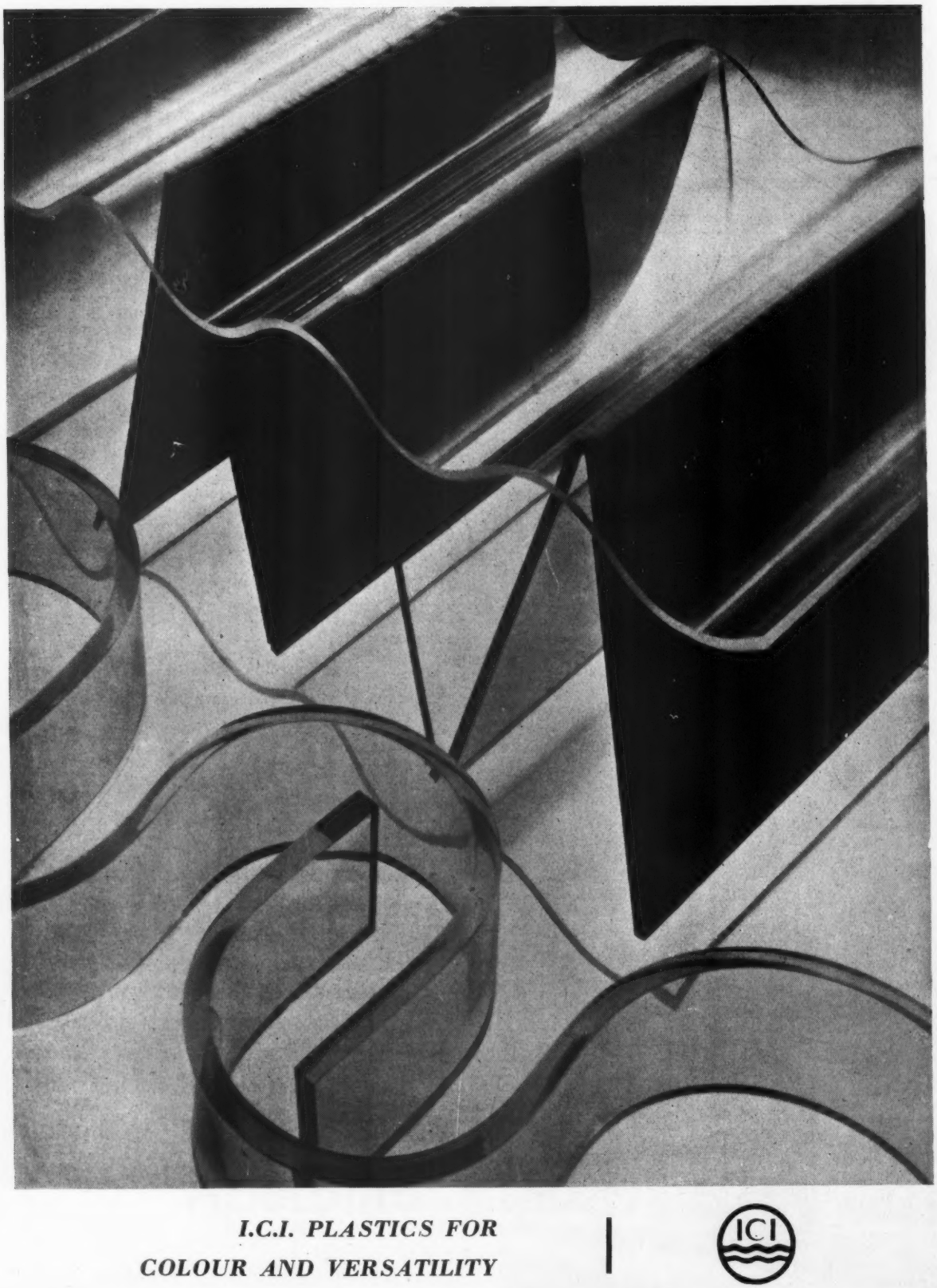
More plastics from petroleum—the distillation unit of the new Shell Chemical Plant, at Stanlow, near Chester.



I.C.I. PLASTICS FOR
COLOUR AND VERSATILITY

ICI

IMPERIAL CHEMICAL INDUSTRIES LIMITED
LONDON, S.W.1

P.335a

Plastics

VOL XIV. No. 147. AUGUST, 1949.

"*Celluloid (Contagion Proof) Collars, Cuffs and Bosoms: a Most Important Discovery.*

"*Although Celluloid Collars have been before the public for the past three years, and their especial qualities as to durability, economy, and general excellence have been thoroughly tested and indorsed by the million, it is only recently that it has been discovered that they serve an important use in warding off contagious diseases, and effectually curing all throat complaints and eruptions of the skin. This is not surprising to the inventor, nor ought it to be to the wearer, when it is known that camphor (one of the best remedial agents known) enters largely into the composition of Celluloid.*"

From an advertisement of Sillcocks and Cooley, 4 Maiden Lane, N.Y. City, in "Harper's Weekly," 4 June, 1881.

EDITORIALS

New Dress for "Plastics"

WITH the present issue of "Plastics" the improvement in paper supplies permits us to return at last to our pre-war size. We hope our readers will be as pleased with the change as we are ourselves.

The so-called pocket size which most technical and trade journals adopted in 1941, or thereabouts, has been called "convenient." From an editorial point of view, however, the small size had little to recommend itself, other than being convenient to slip into one's pocket. The pages of the larger size can be designed with much greater effect or artistry, type can be more varied, important photographs and engineering drawings can be displayed in appropriately larger sizes to give emphasis to technical details. A greater balance becomes apparent throughout.

We do not wish to stress that an important industry gains in dignity with a larger paper, since it can be argued that it is the "meat" within that matters most; but the point has been made and we leave our readers to be the sole judges.

Plastics in Industry

WITH this issue we begin also the first of a series of pictorial reviews under the general title of "Plastics in the Service of Man," each issue dealing with one broad application.

Primarily, we desire to show the industrialists of the world what the plastic moulders and fabricators in this country are doing to-day to serve industry and trade.

To-day is a key-word, for the plastics industry has grown greatly in stature, offering yet a greater number of new materials of construction to add to those already at the service of the industrialist and new moulded and fabricated units of such high quality and design that were not possible fifteen years ago.

Indeed, fifteen years ago, with the exception of the electrical industry, use of plastics in industry was comparatively experimental. To-day they have been accepted, and are understood by technologists and other workers for their special and peculiar properties and segregated for their proper occasions and jobs. For the plastics have their specific functions and are not the panacea for all industrial ills. They will succeed economically and inevitably only when these attributes are understood and applied. Many years ago we wrote:—

"The manufacturers of the world must realize the following few facts. An object, when made from metal, may have to be built up from several separate pieces, the very making of which can entail a waste of 20-50 per cent. of metal. In the building it is crimped, soldered, screwed or welded, sand-blasted and degreased, chromium-plated or painted, varnished, buffed or polished before it can be sold to the customer. A simple metal object may undergo a dozen processes of preparation. The same object in plastics, polished and coloured throughout, can be turned out one, two or a dozen at a time, in two minutes, with virtually no waste of raw material, and needing only packing to be ready for the customer. Moreover, plastics often allow of simpler designs. We leave the industrialist to imagine what economic value this may have on his business."

The same words hold good to-day. But they refer only to the benefits of mechanical operation. What is perhaps more important, the industrialist may choose from a variety of materials for the processes of moulding, extrusion, machining, fabrication and impregnation, with high dielectrical or mechanical strengths, heat or chemical resistance, hard or soft or tough and low weight characteristics, with opacity, transparency or translucency and as colourful as desired. We do indeed produce modern materials and units for modern industries.

We begin this month with the use of plastics in the electrical industry, where plastics first won their medals. With this and succeeding issues manufacturers will judge for themselves how far the plastics industry has progressed.

Deep-freeze Storage

NO social revolution taking place in this country or any other can be greater than that which occupies itself with the health of the nation. And where the health of the nation is concerned, the packaging of its food is of prime importance.

It is strange that this country, which the outside world admires for its extremely high political and social standards, should have retained so long what are quite clearly low standards of distributing food, other than that which is necessarily delivered in sealed bags, boxes and tins.

Even before the war, wrapped bread was rare. To-day, with many difficulties still with us, bread remains unwrapped. Meat, poultry, fish, vegetables and fruit remain exposed to a number of conditions that make assurance of cleanliness and freedom from decay, and therefore from diminished food value, quite impossible. The grocer, green or not so green,

the baker, butcher and fishmonger may start the day with lily-white hands, but we should prefer they didn't touch our food at all. Oh, for a Nature that grew all our food as it does the decorously and satisfyingly covered banana.

To-day, however, we are in the midst of a new social revolution and we can say with fair certainty and satisfaction that if there is one special section of the plastics industry that will advance more rapidly than any other it will be that of packaging film for the protection of food. Indeed, the first signs of packaging "everything" are with us now, from kippers to blankets, from leeks to shirts; we have even seen brocaded chairs wrapped in transparent sheet.

Equally, if there is one section of the engineering industry that also has a great future before it, it is refrigeration, and more especially that portion of it we now call "deep-freeze," which has started a not-so-small collateral social revolution.

In December and January and most of the close season, peas and fruit that taste as fresh as the day they were picked in July and August, and fish that looks nowhere near as dead as the undignified dead on the fishmonger's slab, are now on general sale in the big shops.

Cleanliness and wholesomeness, we have them at last because of "deep-freeze" and good packaging. Many of the answers to the problems are being solved by plastic film and it would seem that, according to the type of food protected, films that are waterproof and vapour-proof are both needed. Regenerated cellulose, rubber hydrochloride and polythene are being used, and we understand that manufacturers are working on the suitability of cellulose acetate for the purpose. The film is being used alone and in combination with waxed cartons.

With these advances comes the news that the lay-flat polythene tube is now an accomplished fact. It is most opportune, since by the use of this thin-walled seamless tube great economies in the time and labour spent in heat-sealing are made. A description of it, obtained from a visit to a recent exhibition held by I.C.I., Ltd., Plastics Division, is given on page 10 of this issue.

MOULDING POWDER AND SHOT

We may not love Mr. Aneurin Bevan like a brother, but perhaps a few moulders have lifted their hats in silent thanks to him since he ordered that Uncle Tom Cobleigh and all may each receive free, gratis and for nothing a couple of pairs of blinkers, a set of plastic gnashers, and a new thatch of golden-coloured nylon, to say nothing of free plastic stoppers for free bottles of medicine. Business is therefore excellent. One mould-maker for plastic teeth tells me he has so many orders that he can promise only six-month delivery.

Plastic Dragon's Teeth

* * *

Another business which has flourished mightily in the past three or four years is that of the "ball" pen, which except for the ball and its metal holder, is almost all plastic, including the thin tube which carries the ink. There has been nothing like it since the "lead" pencil struck the world 300 years ago or more. I make no charge against the "ball" pen as such, but as a friend remarked when he spotted my streamlined "Holdsagallon," is it not a strange coincidence that never in the field of human endeavour have so many pens written so many foolish words?

Seas of Ink

* * *

All good fishermen have already heard of nylon lines, and no doubt have used them to catch bigger and better fish. Yet another type, this time made from the British yarn "Terylene," that is not yet on the normal fabric market, has now been introduced by the well-known suppliers of fishermen's equipment, Milwards, of Redditch. In their pamphlet this firm state that the new lines are stronger, do not stretch, wear harder and where oil dressed are heavier than lines made of similar materials. As the words "similar materials" can presumably refer only to the nylon type, this is an interesting claim. What is also interesting and amusing is that the lines are advertised as "Terylene" Polyester Yarn. We wonder what fishermen make of the middle word!

Fishing Yarn

* * *

Mr. Langdon P. Williams, Director of Public Relations of the Society of Plastics Industry, New York, has sent me a copy of the Informative Labelling Programme compiled by a special committee of S.P.I., composed of members of raw material, moulding and fabricating industries and, most wisely, representatives of selling organizations such as Sears Roebuck Co. (whose fame is world-wide), the National Retail Dry Goods Association, and the National Retail Council. This programme, which is to be one of the means of giving customers a definite idea of quality, is a working one, carefully and clearly laid out for the guidance of members. Excellent examples of labelling are given, the information covering "What it is," "What it will do," "What it is made of," "Limitations" and "Guarantee." This sales promotion will be reinforced by publicity campaigns to the trade by S.P.I. We wish this movement all success, and shall watch its progress closely. We shall comment in greater detail on the programme in our next issue.

Read the Label

* * *

We had been bemoaning the loss to the world of old-time toys, especially that type which came from the Continent, probably Germany, in the form of an enclosed glass dome containing a tiny farm scene or similar model. It was filled with water, and on turning it upside down and then turning it right side up (we hope this is quite clear!) the whole interior was converted into a lovely snow-storm. It was the delight of childhood and of older children between 20 and 80. At the B.I.F., while talking about it to Dr. Mayne at the stand of Vinyl Products, Ltd., the most extraordinary coincidence occurred. A gentleman approached and showed us exactly what we had wanted to see. This time it was a lighthouse scene, and, even more pleasurable, the transparent dome was of "Perspex," the base was a phenolic moulding and the internal scene had been moulded, using "Vinamold" as the mould. The snow was lovely snow, floating gently down over the lighthouse and the ship. How anybody can resist buying this type of toy is beyond me. It is being made by a lady, Kathleen Grossmith, who lives at 58, Park Road, Kettering, Northants, to whom we send our congratulations.

Childhood Regained

DOGSBODDY.

Fig. 1.—The underside of each of these chocolate-coated biscuits has been automatically marked with the manufacturer's name during the "enrobing" operation.

P.V.C. Carries for the Biscuit Industry

AS we have often remarked, it is from the industrial field, rather than from any other source, that we often get a more complete and truer understanding of the behaviour of our finished goods. It is true, of course, that the kitchen utensil or the toy in the hands of a child receives as much hard wear, and perhaps more, but in industry long life is sine qua non, conditions are more varied and problems more complicated, first costs are closely regarded, and there is generally, especially in the case under review, a continual examination by trained observers, such as engineers, chemists, etc., capable of understanding and reporting factually on behaviour. We refer here to biscuit manufacture—an industry in which raw and finished materials are scientifically controlled throughout their use and production.

It is, therefore, with considerable pleasure that we have been able to visit the well-known factory of Chiltonian, Ltd., of Lee Green, London, S.E., and to see in action an entirely novel and, to the general reader, little-known application of polyvinyl chloride sheet, and to report on its behaviour as a conveyor belt in the process of the coating of biscuits with chocolate.

The process of thus covering a biscuit, or "enrobing" as it is called, is as fascinating as it is scientifically interesting, since not only must the methods employed be hygienically perfect and largely automatic, but the physical structure of the chocolate mixture must be rigidly under scientific control, especially during its life in the fluid form as regards the effects of temperature, humidity and other physical and chemical changes.

The biscuits are fed into a Baker-Perkin's "enrobing"

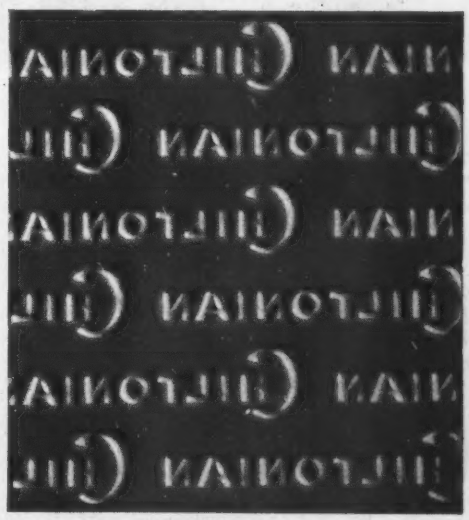


Fig. 2.—Part of the p.v.c. enrobing belt, showing repetition of the name "Chiltonian" embossed in reverse (actual size).

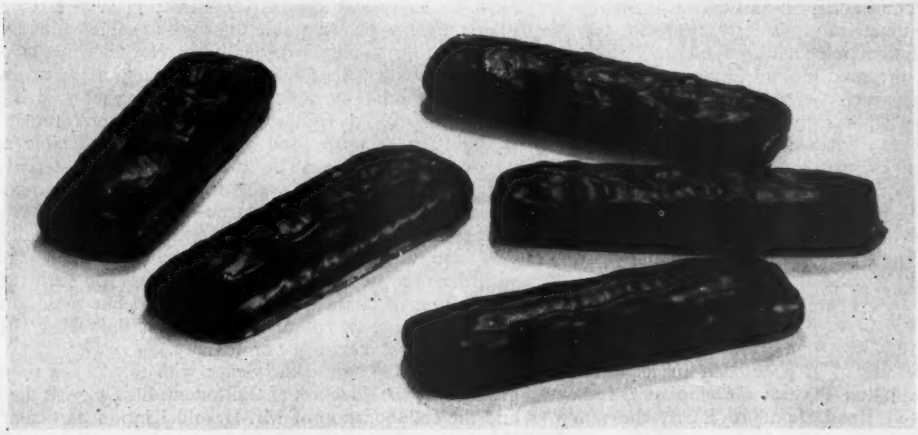


Fig. 3.—The biscuits are here seen from the upper sides.

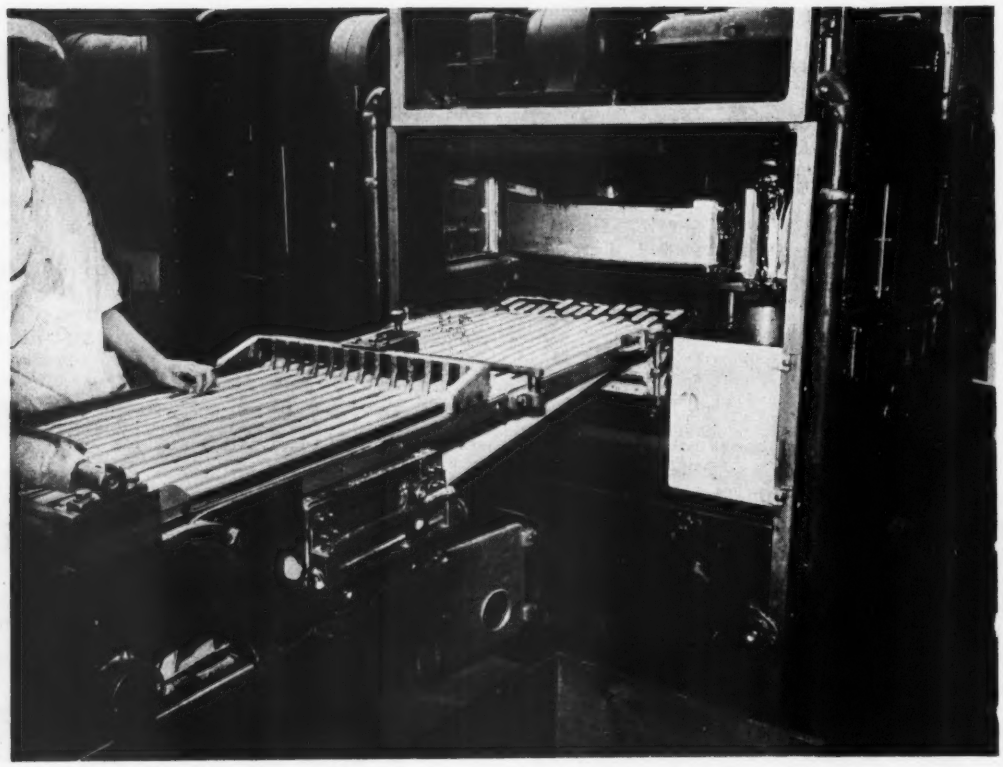


Fig. 4.—In this view of the Baker-Perkins "enrobing" machine, the biscuits are being carried forward on an endless wire-mesh screen to be completely flooded with liquid chocolate from an overhead tank.

machine, which carries them forward continuously on a wire screen into the centre of the apparatus, where they are completely flooded with liquid chocolate from an overhead feed tank maintained at a temperature of about 90 degrees F. Excess chocolate falls through the wire mesh and is recirculated by pumping to the overhead tank.

The completely-coated biscuits with the adhering chocolate still fluid move forward to the "end" of the endless wire-meshed screen, to a second endless "enrobing" belt, which carries them slowly through a cooling tunnel maintained at a temperature of 45 to 60 degrees F. (varying with the temperature of the outside atmosphere). The tunnel is about 25 yds. long (the belt thus being 50 yds. long), and the time of travel being about 10 minutes from end to end.

On arrival at the end of this "enrober" belt, the coated biscuits, cold and set hard and still adhering slightly to the belt, meet a secondary belt, which being at a slightly lower level automatically overcomes adhesion and carries them forward to be packed in containers. It is the "enrober" belt, 50 yds. in length, which is our immediate interest.

Originally the belt on the machine we illustrate was constructed of strong Kraft paper, covered with a special film embossed with the name "Chiltonian" in reverse. Its function, apart from the obvious and most essential one of conveying the biscuits from the enrobing machine and through the cooling tunnel, was to reproduce the name on the base of the chocolate biscuit, and finally to impart to the latter a highly polished surface. It provided all these satisfactorily, but, unfortunately, the life of the belt was exceptionally low —about six to seven days, which entailed consequent weekly dismantling and replacement.

This exceptional problem faced Mr. Harold King, one of the directors of Chiltonian, Ltd., who, with some experience of plastics, suggested the use of a p.v.c. belt in its stead. In collaboration with Arlington Plastics Development, Ltd.. 15-27, Gee Street, Goswell Road, London, E.C.1, the first experimental p.v.c. "enrober" belting was constructed and installed six months ago. It is still working satisfactorily.

Fifty yards long and 24 ins. wide, it is of p.v.c. backed with fabric for added strength and to resist stretching, although tension is not great, and is of an overall thickness of 20/1,000 in. The word "Chiltonian" is embossed throughout its length and breadth, and is still as clear-cut as it was at the beginning. The original highly polished surface has lost some of its lustre during these six months, but such service is deemed satisfactory. Judged purely from the theoretical and experimental angle, it seems probable that a very slightly harder p.v.c. (good flexibility must, of course, be retained), with slightly less "wetting" power of the surface, would lengthen the life of the surface considerably. The life of the belt itself appears unimpaired so far as its main function is concerned

A noteworthy aspect of this case jumps to the eye—there must be many applications of plastics in such factories and others, if only we were able to see the problems involved.

In our tour of the factory with Mr. Harold King, he pointed out other matters that warranted examination. For example, what the biscuit industry requires for special jobs is a very flexible plastic material capable of being perforated, which would keep its shape and yet remain very flexible and, of course, be non-toxic. The thickness of this material should be about $\frac{1}{8}$ in. and the width 6 ins. He is also anxious to examine the possibility of plastic trays for internal transport in the factory, to replace the wooden trays normally used. They are roughly 16 ins. by 16 ins. by 8 ins. high, reinforced with metal corners, and thousands are used in such factories, but price is of considerable importance. The main attributes are resistance to exceptional hard wear in the factory, hygienic properties and complete non-toxicity.

In conclusion, we acknowledge with thanks the permission given us by the directors of Chiltonian, Ltd., to visit the works, and the collaboration of Mr. Harold King in particular.

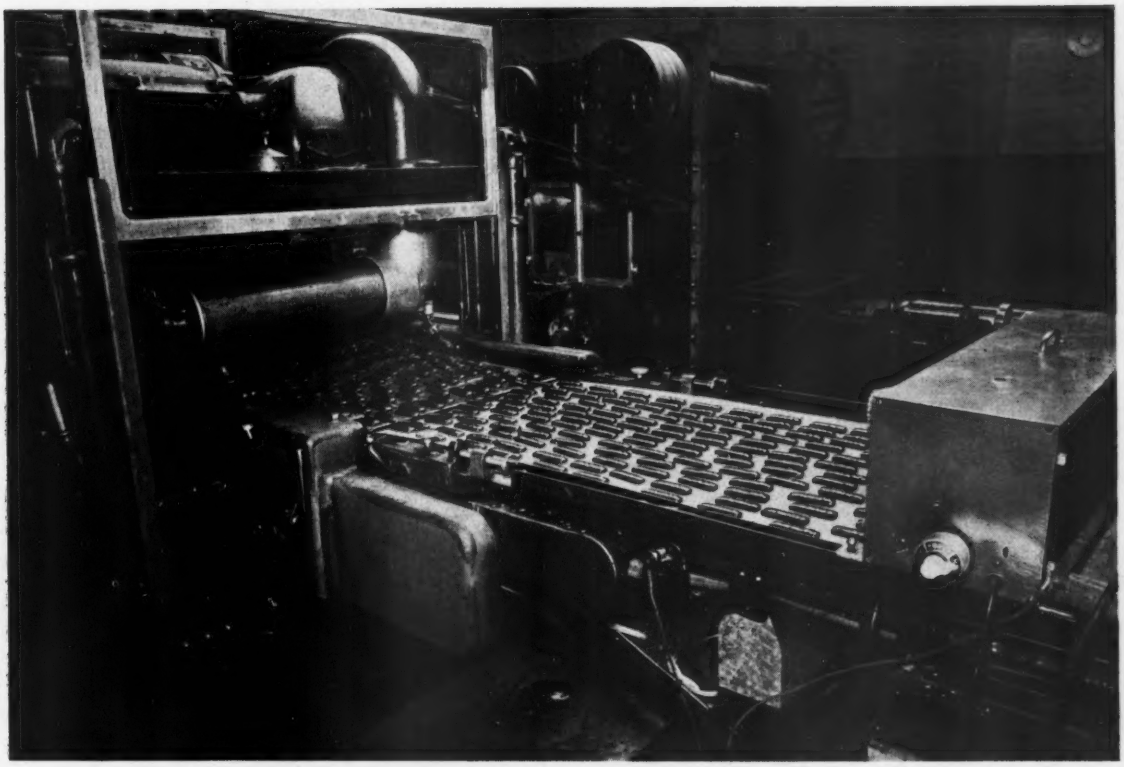


Fig. 5.—The biscuits, now completely coated or "enrobed" with chocolate, transfer from the endless wire-mesh screen to the endless p.v.c. belt which carries them through the cooling tunnel.

Fig. 6.—The coated biscuits, cold and hard, finally transfer to a secondary endless belt, which carries them forward to be packed.

New Polymer Solutions

WHILE the main interest of the thermoplastic polymers, like the resins of the phenolic and urea condensations, lies in their mouldability, there are very large fields in which the polymers are employed in solution form to obtain thin films of the resin which act as coatings to structures in one form or another. In the polymer field the polyvinyl chlorides and acetates are already well known as film formers. So also, indeed, are the phenolic and urea resins, which, much earlier than the polymers, have been used as electrical or decorative lacquer bases.

The following notes refer to a comparatively new series that has now been produced, and are of special importance in view of the generally high solid content of the solutions without giving unduly high viscosities.

Polymethyl Methacrylate Solutions

Solutions of polymethyl methacrylate, containing 40-45 per cent. of solid unplasticized resin, are capable of producing excellent thick films. They are specially characterized by being water-white, glossy, tasteless and odourless, resistant to strong acids and alkalis, insolubility in many solvents, such as alcohols, petrol and the like, fats and greases. They are also unaffected by ageing, oxidation, ultra-violet and sunlight. Furthermore, the films formed from such solutions are tough and resistant to abrasion, have excellent electrical properties, and are unaffected by micro-organisms. An additional and interesting property of these polymethyl methacrylate films is that they do not become tacky, even on heating to 200 degrees C.

Their use, therefore, is very attractive in a variety of fields which include their use as paper varnishes, petrol-resistant finishes, anti-sulphuric enamels, insulating varnishes, wood-finishes, food-container lacquers, and leather and cloth finishes (especially as single-coat deposits). Another interesting application is in the treatment of p.v.c. paste coated fabrics to overcome tackiness and to impart high gloss.

Almost any degree of flexibility can be imparted to these films by suitable plasticization with many of the usual type of plasticizers: phthalates, phosphates, sebacates, chlorinated diphenyls, have proved satisfactory, in quantities varying between 15 and 40 per cent. according to the application. All the polymethyl methacrylate solutions under consideration can be thinned with chlorinated hydrocarbons, ketones, esters, benzol, toluol, etc. Furthermore, they are compatible with nitrocellulose, polyvinyl acetate, polyvinyl chloride, phenol-formaldehyde, etc. They are incompatible in the unplasticized state with polystyrene, cellulose acetate, urea- and melamine-formaldehyde, and silicones.

Polybutyl Methacrylate Solutions

The new variation of "acrylics" is produced as a low molecular weight material in toluol. Two differences between the polybutyl compound and the polymethyl compounds are that the former is produced with a higher solid content than the latter, namely 50 per cent., and that much smaller quantities of plasticizer are required to obtain high flexibility, 10 per cent. being sufficient for most applications.

This solution gives films of a similar type to those made from polymethyl methacrylate solutions, so far as resistance to ageing, sunlight and oxidation, acids and alkalis are concerned. The films can be heat-sealed.

In addition to its use in paints, lacquers and varnishes, it is specially recommended for producing leather top-finishes, and as an adhesive especially for surfaces normally difficult to bond.

Polystyrene Solutions

Polystyrene, as an ingredient for paints, lacquers, etc., has recently been in the news concurrently with the large-scale manufacture of the polymer from petroleum sources.

The solution under review is especially noteworthy in being free-flowing, yet containing as high as 60 per cent. solids. Compared with solutions of commercial styrene polymer (that is, polymer of higher molecules weight), it permits thrice the solid content for a given viscosity, thus allowing the formation of very heavy coatings with one application. Spraying is possible with a solution containing 40 per cent. solids.

Here, again, good electrical properties, resistance to strong acids and alkalis, high resistance to scratching, make the films admirably suited as insulating varnishes, paint primers, metallic paint media, and acid-resisting finishes. It is also obviously indicated for cement, concrete and plaster paints.

International Plastics Exposition in Norway

AN international plastics Exposition is to be held in Oslo (Norway), September 19 to 30, under the joint sponsorship of the Norwegian Industries Development Association and the Norwegian Plastics Federation. In connection with this exposition, a plastic conference has also been arranged and will be attended by manufacturers from all Scandinavian countries. Attendance on the first four days will be restricted to industrialists and government officials; the general public will be admitted for the remainder of the time.

The exposition is being planned to emphasize the recent strides made by the plastics industry in a wide number of fields covering raw materials as well as applications of plastic products. Its main task is to show the industrialists and government authorities the important rôle of plastics in modern industry; also to convince the authorities of the necessity of granting sufficient currency licence for imports.

It is intended that the exhibits shall have a high technical standard, and show the currency-granting authorities that plastics are no longer just luxury and fancy articles, but are becoming a necessity in the development of industry, and in obtaining a higher living standard. There will be no display of ordinary finished articles from different moulders, as seen at most plastics fairs. The displayed material will consist of the different types and grades of all the raw materials, and the different intermediate products, which in one way or other form a basis for industrial usage.

Finished articles will be displayed only in those cases where they demonstrate the use of new raw materials, or otherwise represent new and interesting applications. Finished articles representing the more advanced moulding, extruding, shaping or welding technique, however, will be shown.

In addition to raw materials and intermediate products, plastics machinery and testing equipment will form an interesting part of the display.

It is hoped that British manufacturers will participate. The material which is to be displayed will have to be in Oslo at least eight days before the opening of the exposition on September 19. Further information may be obtained from Studieselskapet for Norsk Industri, Munkedamsvn 53b, Oslo, Norway. (Telegraphic address: "Studieselskapet.")

Silicone Insulation

MAXIMUM working temperature for silicone rubber-insulated cables and wires manufactured by British Insulated Callender's Cables, Ltd., is to be raised to 150 degrees C. These cables and wires may also be employed at temperatures considerably below freezing point.

Typical applications of cables with silicone rubber insulation include their use as thermocouple leads, as instrument leads and connections in boiler houses, for wiring drying kilns, furnaces, ovens, ships' engine rooms and gas-turbine aero-engines. British Insulated Callender's Cables, Ltd., manufacture cables and flexibles with this type of insulation having conductor sizes to B.S.7. Insulating sleevings in a wide range of sizes and colours can be supplied.

The principal reasons why silicone compounds possess remarkable temperature stability are the presence of the silicon atoms and the strength of the silicon-oxygen bond. Further, compared with asbestos and glass as insulants for high temperatures, silicone rubber combines greater flexibility and resistance to moisture, as well as the ability to withstand, continuously, without deteriorating, a wider range of temperatures.

The "Nebro" lantern slide cabinet shown is an example of the manner in which the efficiency and eye-appeal of many ordinary objects can be enhanced by good design and by plastics. Moulded by Rootes Mouldings Ltd., of Slough, for Neville Brown and Co. Ltd., London, and designed by W. M. de Majo and P. Harvey, the base is in phenolics and the cover in urea.

The "Perspex" carving is yet another example of the advances made in the delicate and exquisite art of "reverse" engraving. The specimen has been forwarded to us by The Crescent Studios, Chapel-en-le-Frith, Stockport.

World's Industry Employs Plastics

GENERAL ENGINEERING

Conveyor belt.—With belt tensions as high as 1,000 lb. per inch of width, a high-tension fabric belt ("Raynile") has been developed; it is composed of rayon and nylon. The maximum tension which can be carried is almost double that of a 48 oz. cotton fabric. The producer is Hewitt Rubber Div., Hewitt-Robins Inc., Buffalo, N.Y. ("Machinery" (N.Y.), 1949/Mar./188.)

Textile machine part (flyer block) of nylon plastic needs no lubrication at speeds as high as 15,000 r.p.m. The danger of throwing oil on the yarn, as with lubricated flyer blocks, is thus avoided. ("Machinery" (N.Y.), 1949/Mar./189.)

Densified wood. — This material, impregnated with Bakelite phenolic resin, is harder than any solid wood and lighter than any solid metal. The production physical properties and some applications are discussed; for instance, the use as pattern for forming cast-iron gear blanks. ("Machinery" (N.Y.), 1949/Mar./185.)

Silicones for extreme temperatures.—A new silicone rubber is said to be extremely useful for gaskets, diaphragms, washers, packings, etc.; it retains rubber-like qualities and elasticity at temperatures ranging from −150 to 500 degrees F. The manufacturers are Stalwart Rubber Co., 157, Northfield Road, Bedford, Ohio. ("Machinery" (N.Y.), 1949/Feb./194.)

Small-scale injection moulder by Plastics Development Corp., 225, Lafayette Street, New York 12, N.Y., used on a drill press, permits small-scale injection moulding of polystyrene plastics in laboratories, home workshops, etc. The thermostatically controlled heat range is 250 to 500 degrees F. ("Business Week," 1949/Apr. 9.)

Phenolic moulding powders of low cost for general purposes have been developed by General Electric Co., Chem. Dept., Pittsfield, Mass., in black and brown and for compression and transfer moulding. Although not having high-gloss or long-draw mouldings, these powders are said to be satisfactory for the majority of thermosetting plastics applications. ("Materials and Methods," 1949/Mar./98.)

Development survey.—At the VDI Conference in Munich, 1948, R. Vieweg gave an interesting survey of the development of plastics in recent years, recognizing in particular the outstanding progress made in foreign countries. Important developments have taken place in silicone chemistry leading to new branches of plastics; the physical aspects of plastics have been further developed; and in technology, larger presses and injection moulding machines have been perfected. New types of materials, for instance, of sponge-like structure, are also being produced. ("VDI-Zeitschrift," 1948/90/331.)

Standards.—A survey by W. Euler and G. Ehlers deals with the organization of the German Standards Committee on Plastics, as well as the actual work done by working committees on definitions, classification, typization, control of plastics, plastic foils, artificial leathers, cements and glues, and testing methods. ("Kunststoffe," 1949/May/114.)

H.F. preheating devices.—K. Stoeckhert gives a general survey of plastic preheating machines. Apparatus produced by the Radio Receptor Co., Inc., New York, is described; also the devices of six other American producers. Among British devices, only those by Delapena and Son, Ltd., and British Insulated Callenders Cables, Ltd., are mentioned. ("Kunststoffe," Vol. 39, 1949/Apr./91.)

MISCELLANEOUS

Corrosion-resistant coating, "CycLon," is said to be easily applied to protect metals, wood and ceramic surfaces against corrosive fluids. It dries quickly in the air by solvent evaporation. ("Machinery" (N.Y.), 1949/May/169.)

Glue for redwood veneer.—A new thermosetting phenol-formaldehyde glue which overcomes the presence of tannic acid and the alkali content of redwood veneer is announced by M. and M. Woodworking Co. Under hot-plate presses the glue becomes insoluble alkaline, and dries before it penetrates the veneer. ("Business Week," 1949/Feb. 19/46.)

Coating tape.—An improved orange-coloured synthetic resin tape for insulating plating racks, called "Wrap-Rax" (Hansom - Van - Winkle - Minning Co., Hatawan N.J.), is said to be effective as "stop-off" in hard chromium and other plating solutions. ("Machinery" (N.Y.), 1949/Mar./1,888.)

Sound damping.—I. A. Sauer and W. J. Olephant report on their investigations on the damping and resonant load-carrying capacity of polystyrene and other high polymers. Using the resonant method, the energy absorbed per cycle has been measured as a function of stress amplitude. The damping capacity varies as the stress to the 2-3 lower. (Abstract, A.S.T.M. Bulletin, 1949/May/16.)

Artificial leather.—K. Werner discusses the changes which have been made during recent years in the use of plasticizers in the production of artificial leather. The trend is to change from natural to synthetic plasticizers. In particular, polyvinyl chloride and polysuperamide cannot be worked together with natural raw materials. ("Kunststoffe," 1949/May/121.)

Film Standards.—The Society of the Plastics Industry announced in 1946 the formation of a division to foster the development of standard methods for evaluating cast and calendered films, etc. F. J. Groten, however, surveyed the work done during previous years. ("Standardization," 1949/Feb./32.)

Examination of metal powders.—In a new method for the examination of fine metal powder particles with the electron microscope, a thick paste of powder and Aerotex M-3 (water-soluble melamine formaldehyde plastic), spreading on thick glass and polymerizing. Specimens can be polished and etched as usual and examined by formvar or parlodion replicas. ("Journ. Metals," 1949/Mar./Sect. 3/228.)

Plasticizers.—Following recent reports on the poisonous nature of tricresyl phosphate when used as plasticizer, H. Berger deals scientifically with all problems connected with the use of this chemical. ("Kunststoffe," 1949/Mar./65.)

Thermosetting plastics.—A comprehensive manual on thermosetting plastics, sub-divided into phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, polyesters, and special-purpose plastics, has been compiled by K. Rose. ("Materials and Methods," 1949/May/71.)

Rubber-like materials. — The latest A.S.T.M. standards on rubber and rubber-like materials, published by A.S.T.M., provides a 600-page book containing 81 A.S.T.M. standards and tentatives. (A.S.T.M. Bulletin, 1949/May/25.)

Dielectric measurements.—An introduction to the physics of the dielectricum is given by Th. Gast. This survey is of particular importance, owing to the increasing use of high-frequency heating and preheating of plastics, as well as the welding of thermoplastics ("Kunststoffe," 1949/Apr./81.)

Developments in Permanent Display Material

NOTABLE developments in the technique of printing in laminated plastics, which are expected to find wide application in the practice of advertising and display, are announced jointly by Thomas De La Rue and Co., Ltd. (Plastics Division), and Leon Goodman Displays, Ltd.

It was two years ago that Thomas De La Rue and Co., Ltd., were responsible for the introduction of British-made "Formica," which is a decorative laminate with the hardest known surface for this type of material. Research into its uses as a permanent display material was carried out by W. M. Dixon, A.R.C.A., of the De La Rue Design Section, aided by the laboratory technicians and the printers. Experiments carried out in the laboratory of the De La Rue factory at Tynemouth recently overcame certain technical difficulties in the interlaminate printing of letterpress. Subsequent co-operation with Leon Goodman Displays has now resulted in the production of full colour silk-screen interlaminate printings.

Interlaminate printed crest, in full colour, for the Hadrian bar on the Tees-Tyne Pullman. This is an example of the earlier printings in "Formica."

In their simplest form, laminated plastics are produced by heating and pressing a number of sheets of resin-impregnated Kraft paper until polymerization takes place and the sheets are no longer capable of separation. Decorative laminates, such as "Formica" and "Traffolyte," have on top of the sheets of Kraft paper a decorative sheet printed with the required design and colour. In the case of "Formica," a further translucent sheet, impregnated with a special resin, is added. This gives the unique hard and impregnable surface possessed by this material. If the decorative sheet may be printed, it follows that any printed matter may be substituted and so pressed indestructibly into the surface.

Letterpress work can be used for the production of printed material in single-sheet form. The printed matter is impregnated with resin and pressed into the normal "Traffolyte" sheet in sizes up to 8 ft. by 4 ft.

For silk-screen printing, either "Traffolyte" or "Formica" may be used, the latter having the advantage of its unique hard surface. Special inks and paper are required, as the inks must be capable of withstanding great heat and must be fast to light. For the technical preparation of this material the co-operation of the silk-screen printer is necessary, as special screens to withstand wear and chemical action are required. Inks must print solid, without bleeding and without interfering with bonding.

Previous uses for the interlaminate printing process have been concerned mainly with the production of signs, notices, charts, etc. Their advantages are permanence, legibility and complete cleanliness. With the development of these new techniques the widest field for future exploitation is opened. Indestructible murals in full colour, showcards, permanent advertisements of all types for indoor use, and display and exhibition work, now offer to architects, designers and publicists new opportunity for creative work.

Leon Goodman Displays, Ltd., hold the exclusive printing rights for this new process, but the closest co-operation is maintained with the De La Rue Design Section, laboratory and factory.

This original mural, designed by W. M. Dixon, A.R.C.A. of the Design Section, Thomas De La Rue and Co., Ltd., is interlaminate printed in "Formica." It was exhibited at the 1949 B.I.F.

L

"Alkathene" Lay-flat Tube

ON July 8 at the Park Lane Hotel, London, I.C.I., Ltd., Plastics Division, held an exhibition to show the latest development in packaging in polythene sheet. "Alkathene" sheet is now being made in the form of a tube which lays quite flat. When a length of this tube is filled, only the two ends need be sealed; thus its introduction in packaging envisages important economies.

At present lay-flat tube for film thicknesses of nominal 0.0025 in. is available in widths of 3 to 5 ins., increasing by ½-in. steps (i.e., tube diameters from 1.91 in. to 3.17 in.).

Between now and the end of 1949 enough lay-flat tube will be available for extensive packaging trials and market evaluation. The range is being increased to include widths from 2 ins. to 24 ins. (i.e., 1.27-in. to 15.7-in. tube diameters) and thicknesses from 0.0015 to 0.005 in. Large-scale production capacity will be ready by the beginning of 1950.

The introduction of lay-flat tube coincides with the coming into operation of the first large-scale plant for the production of "Alkathene" film in Great Britain. The Plastics Division of I.C.I. can now supply "Alkathene" film in continuous rolls up to 46 ins. in width. Hitherto manufacturers have been unable to obtain commercial quantities of this film for the packaging of foodstuffs, chemicals and pharmaceutical goods and engineering components, but regular deliveries are now maintained.

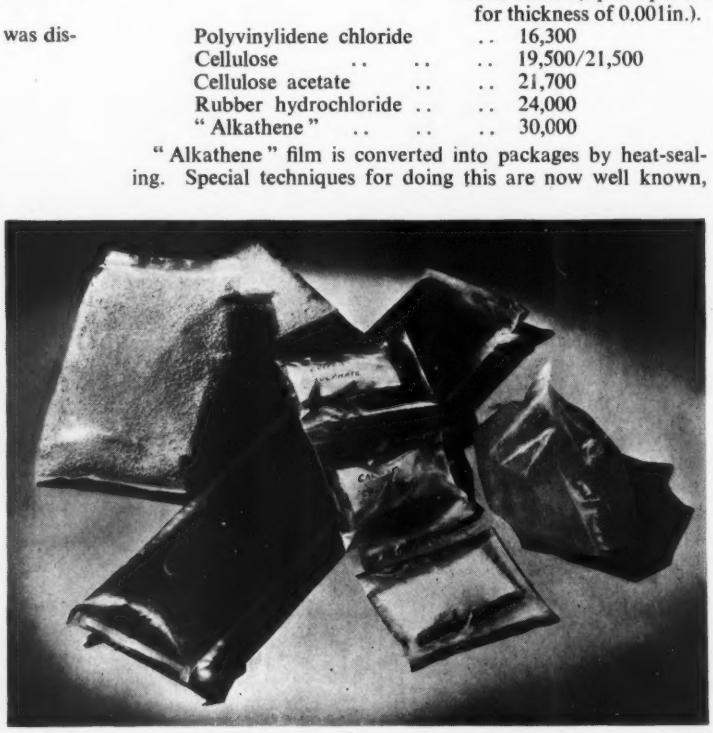
"Alkathene" lay-flat tube and "Alkathene" film are distinguished by good transparency and high resistance to water, water vapour and chemical action. They remain flexible down to temperatures as low as −60 degrees C. Under ordinary service conditions, appearance, handle and physical properties are unaffected, though prolonged exposure to bright sunlight, especially in the tropics, may cause some embrittlement.

"Alkathene"—the I.C.I. brand of polythene, which was discovered and developed in the company's laboratories—is the lightest plastic known. As film, its cost per pound compared with traditional packaging materials appears expensive, but on an area basis—which is the important factor in packaging—the cost is more favourable. The following figures show the area coverable by 1 lb. of several transparent films in equal thicknesses:—

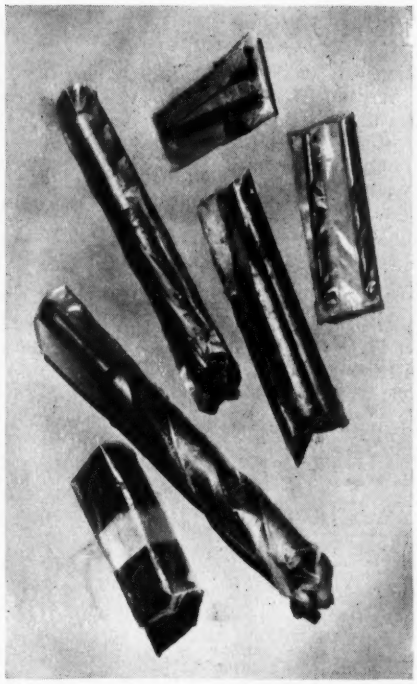
The new "Alkathene" lay-flat tube is supplied in rolls for the general convenience of the user.

	Area factor (sq. ins. per lb. for thickness of 0.001in.).
Polyvinylidene chloride ..	16,300
Cellulose	19,500/21,500
Cellulose acetate	21,700
Rubber hydrochloride	24,000
"Alkathene"	30,000

"Alkathene" film is converted into packages by heat-sealing. Special techniques for doing this are now well known,



"Alkathene" lay-flat tube may be employed alike for the packaging of (left) fresh vegetables and fruit, especially for the "deep freeze" sales service, and (right) chemical and pharmaceutical products.



(Left and above) Tools of all types, and small engineering components, are protected against corrosion in storage and transport by "Alkathene" lay-flat tube used as packaging and heat-sealed.

and suitable machines are available. With the advent of the lay-flat tube, the job of conversion will be greatly simplified for many applications. The film can be printed, but special inks are required.

The properties of "Alkathene" immediately suggest its use in film form as a protective packaging material for foodstuffs, chemicals, metal components and other commodities. Such packs have already proved their value for chemicals and pharmaceuticals, i.e., as bags or drum liners to hold corrosive, hygroscopic and dermatitic materials, and wet pastes.

As regards the packaging of foodstuffs, "Alkathene" film is particularly suitable for deep-freeze and quick-frozen foods. Because of its toughness and flexibility at low temperature it does not shatter. It transmits very little moisture vapour at normal temperatures, and even less at temperatures below freezing point. This is important in preventing "freeze burn," i.e., dehydration of the food. Goods of irregular shape, such as chickens, are attractively packed in "Alkathene" film. This material is also ideal when the commodity demands not only protection against moisture but also good display.

The ability of "Alkathene" film to withstand a wide range of climatic conditions also makes it specially valuable for the storage of machinery, metal components, instruments and electrical equipment of all kinds, especially those being consigned to tropical countries. It has been selected by the Ministry of Supply for packing and preserving electrical resistors, in preference to the more expensive and complicated wax-dipped packs. The advantages obtained are: (1) lighter weight, (2) reduced labour costs, (3) better performance (especially at high temperatures), (4) transparency combined with good mechanical strength, and (5) unit rather than bulk packaging.

There is little difficulty in heat-sealing "Alkathene" film, provided the right methods are employed. Heat-sealing machines designed for cellulose films cannot be used, because "Alkathene" sticks to the heater elements. An operating time cycle must be arranged, whereby the film is heated (temperature about 150 degrees C.), sealed under pressure, and allowed to cool before the pressure is released. This cycle should be applied to both static and continuous heat-sealing machines. In the latter, two synchronous endless metal bands convey the film through the hot and cold zones. Speeds up to 30 ft. per minute have been obtained.

To assist in the separation of the film from the heater elements it is advisable to provide a protective layer of "Fluon" (polytetrafluoroethylene) film on the static type of sealer, and a coating of silicone grease on the continuous type of machine.

From 300 degrees C. upwards there is another temperature range suitable for sealing. At these temperatures the film does not stick to hot metal surfaces, and good seals can be obtained provided the time of contact between heater and film is short and only light pressure is applied. This method can be used for continuous sealing, where the time of contact can be regulated by the speed of the film. This method lends itself to the design or modification of machinery to make bags on a high-speed production basis.

Ordinary high-frequency sealing cannot be used with "Alkathene" film because of its remarkable low power factor. Seals can be made, however, if a strip of another material, which can be heated by high-frequency current, is used as a buffer between the "Alkathene" film and the electrodes of the machine.

For details of the best heat-sealing techniques for specific applications, interested users should consult the Technical Service Department of I.C.I., Plastics Division, Welwyn Garden City, Herts.

B.P.F. Aims and Organization

The history, purpose and functions of the British Plastics Federation are set forth in a 12-page brochure (Publication No. 22) which the Federation has just published.

The Federation was formed in 1933, with the aim of promoting co-operation between manufacturers in the plastics industry. It promotes close liaison between Government Departments and the various branches of the industry, advances the interests of the industry generally, and in routine activities helps individual members to solve the practical problems which confront them.

The present brochure sets out in some detail the conditions and benefits of membership, so that both present and prospective members may have at hand a useful reference. Membership is open to all bona fide British firms, i.e., those whose principal place of business is situated in the British Empire, who manufacture and sell plastic products, raw materials or equipment, in or for the plastics industry.

At present the Federation has six main groups, i.e., plastic material manufacturers, moulders, laminated and fibrous products, fabricators, engineers, and raw material suppliers, which collectively comprise about 24 individual sections. A diagram included in the present brochure shows the general organization at a glance. Copies may be obtained on application to The British Plastics Federation, 47-48, Piccadilly, London, W.1.

Welding of Plastics Exhibit

DURING the period of the B.I.F. an exhibition of specialized products and processes by Rediweld, Ltd., was held at Carlton House, Lower Regent Street, London, W.1. This company has carved out a special niche within the plastics industry and deals almost solely in the welding of plastics—more specifically of plasticized and unplasticized polyvinyl chloride and of polythene.

The type of industries covered by welded plastics up to the present are not numerous, but they are exceptionally important. Thus the welding of plasticized p.v.c. includes the high-frequency welding of sheet p.v.c. to produce a wide range of objects, such as waterproof clothing and a host of fancy and small utility goods ranging from note cases, spectacle cases and thin sheet bags for waterproof packaging. The welding of unplasticized, that is, hard p.v.c., is carried out by hot-gas welding and covers at present one field only, namely, the chemical industry, where the exceptional resistance of the material makes it very attractive to manufacturers and users of acids and other chemicals.

Polythene, on the other hand, can only be welded by heat welding. Broadly speaking, the industries in which this plastic is employed, other, of course, than the electrical industry, are again the chemical industry and the packaging industry.

The accompanying photographs show a large number of exhibits which cover the above fields. In Fig. 3 will be seen two high-frequency welding machines, one a small 300-watt type and the other a larger automatic 1½-kW type.

Fig. 2 (right).—Woven p.v.c. protective clothing for industry.

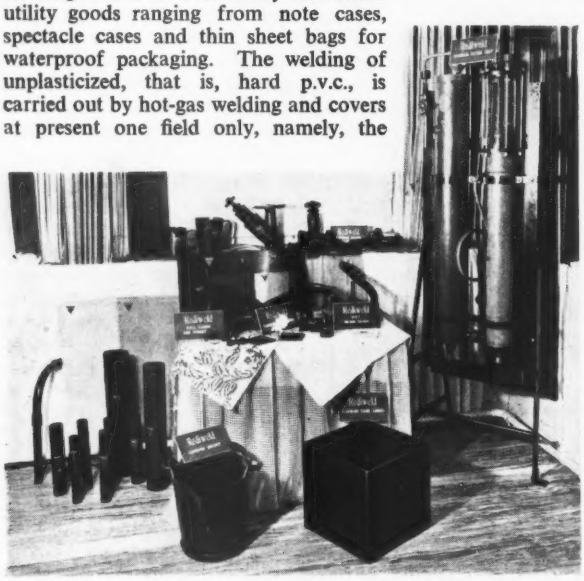


Fig. 1.—Valves, bucket, tank lining and a filter unit of welded hard p.v.c.

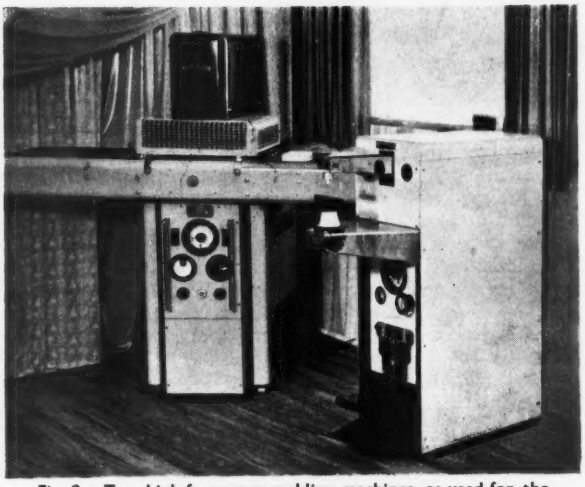


Fig. 3.—Two high-frequency welding machines, as used for the welding of plasticized p.v.c.

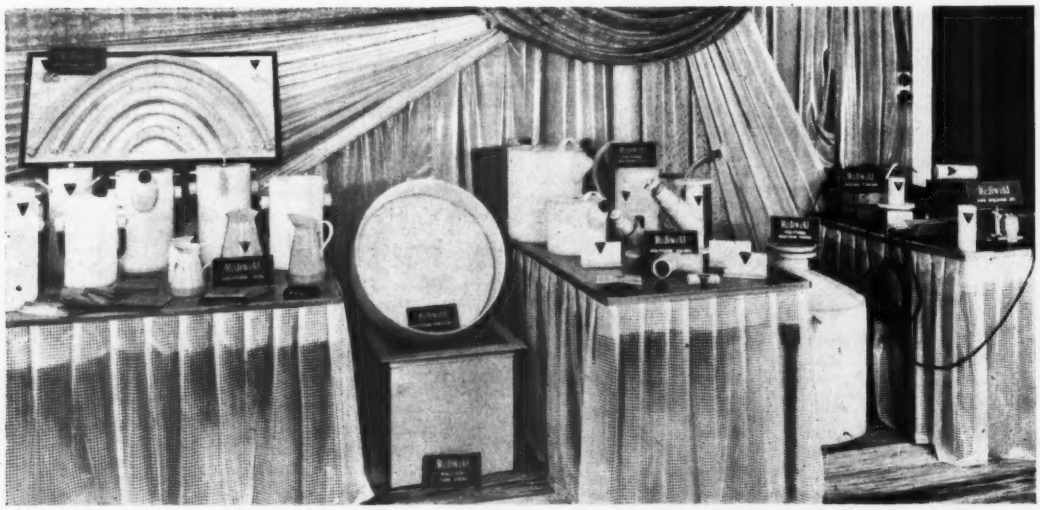
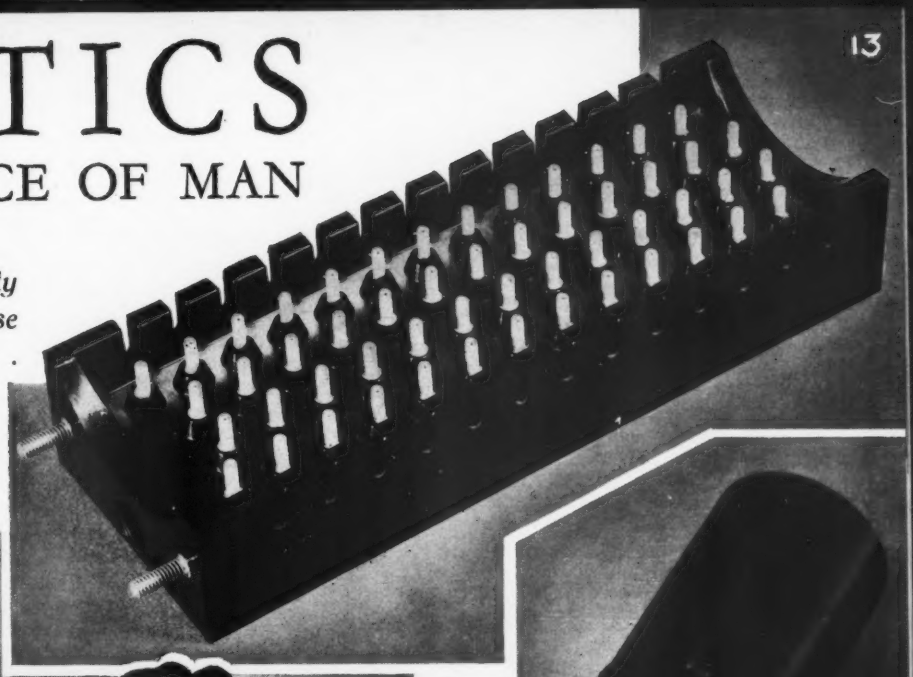


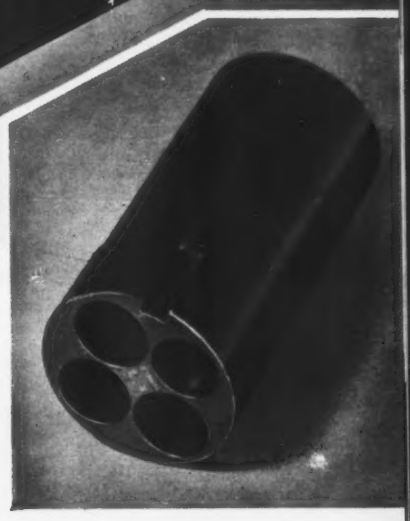
Fig. 4.—Part of the exhibit, showing heat-welded polythene in the form of tubing, acid jugs, tank linings, valves and reaction vessel; (extreme right) welding torches and a pipe-welding jig.

PLASTICS
IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

1. Electrical Industry

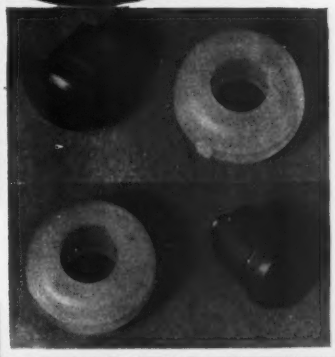




(Top) Rectangular moulding with a large number of terminal inserts, manufactured generally for the telecommunications industry by The Phœnix Telephone and Electric Works, Ltd.

(Above) Insulator moulded in phenolic by Lustroid, Ltd., for A. Reyrolle and Co., Ltd. This is a particularly intricate job, with very high tolerances.

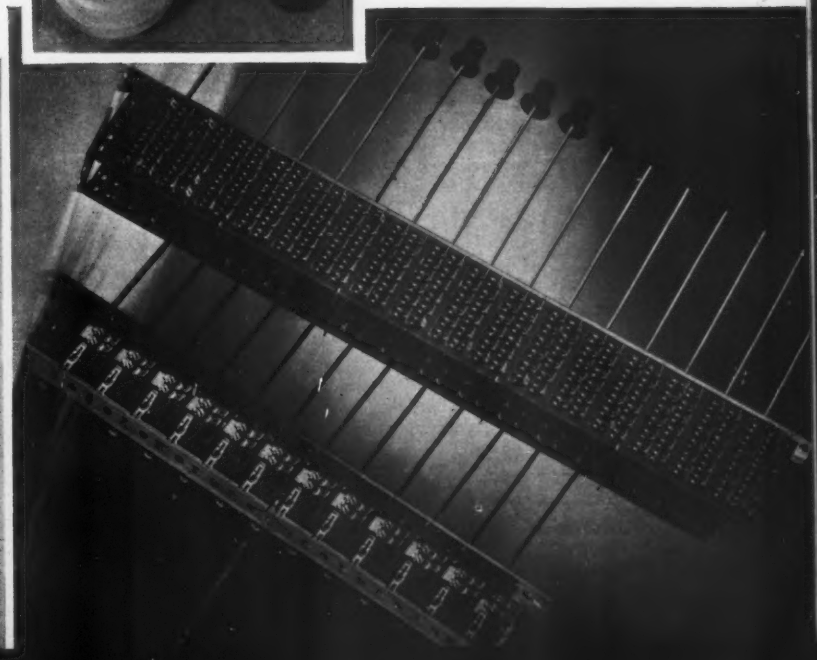
(Below) The ease with which "Bakelite" laminated lends itself to complex punching operations, has led to its wide adoption for insulating applications. This push-button switch is produced by British N.S.F. Co., Ltd. (Courtesy, Bakelite, Ltd.)

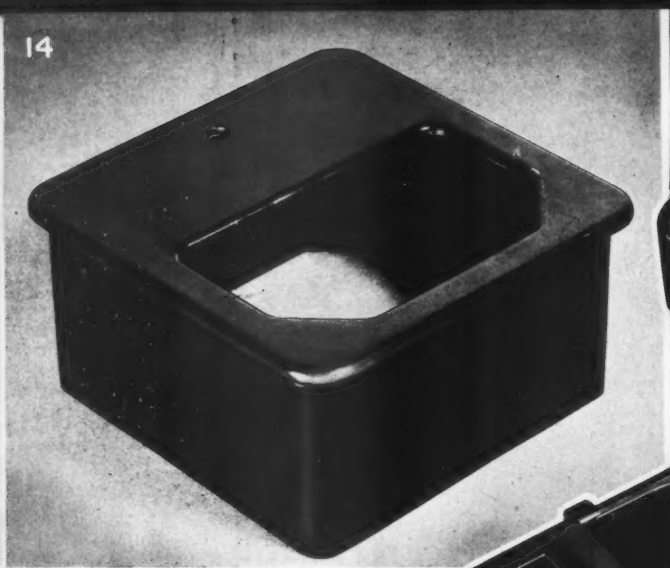


(Above) Connection sockets in mineral-filled "Beetle," for aircraft magnetos, by Rotax, Ltd. (Courtesy, B.I.P. Ltd.)

(Right) Insulating grommets by J. F. Kenure Ltd.

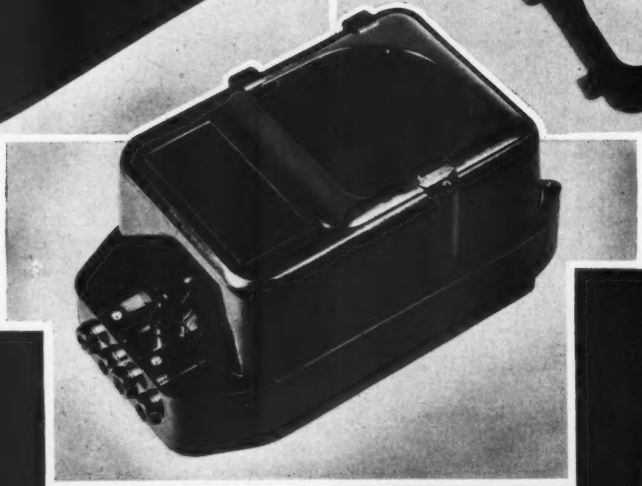
(Below) Thermosetting moulding by Joseph Lucas Ltd. (Courtesy, I.C.I. Plastics Division.)



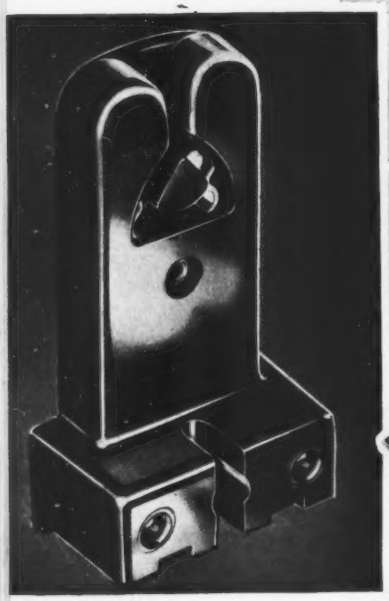


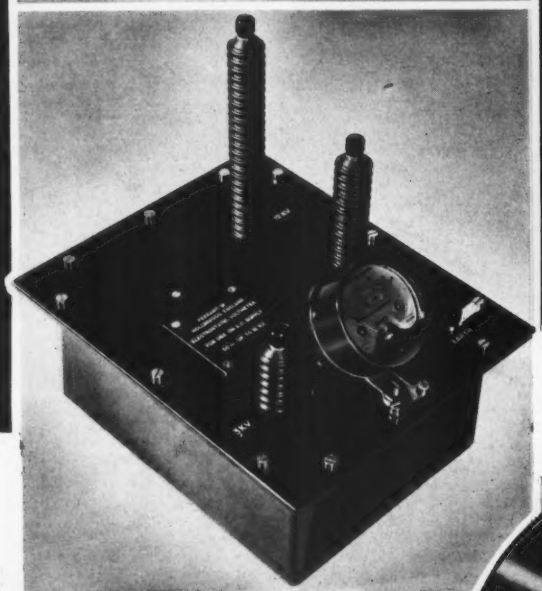
(Above) Instrument case by The Phœnix Telephone and Electric Works Ltd., as supplied to Everett Edgcumbe, Ltd.

(Below) "Ekco - Ensign" Bi-pin lampholder for fluorescent lamps —a phenolic moulding by E. K. Cole, Ltd., Plastics Division.



(Above and left) Meter case for Venner Time Switches Ltd., as exported to Australia, moulded in "Bakelite" by Ebonestos Industries, Ltd.



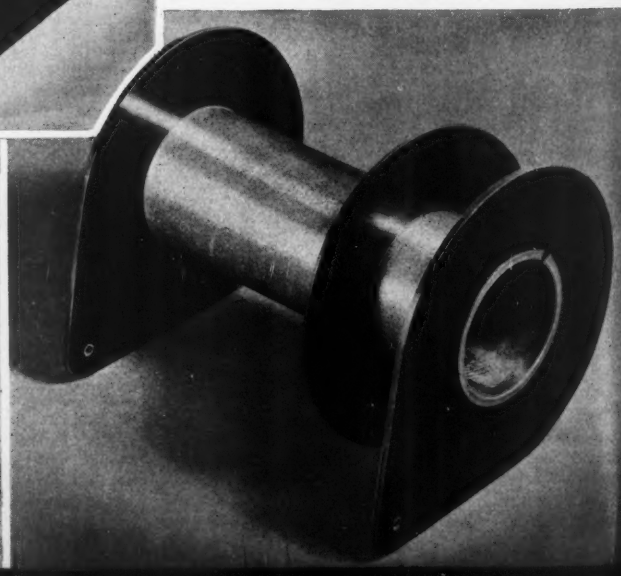


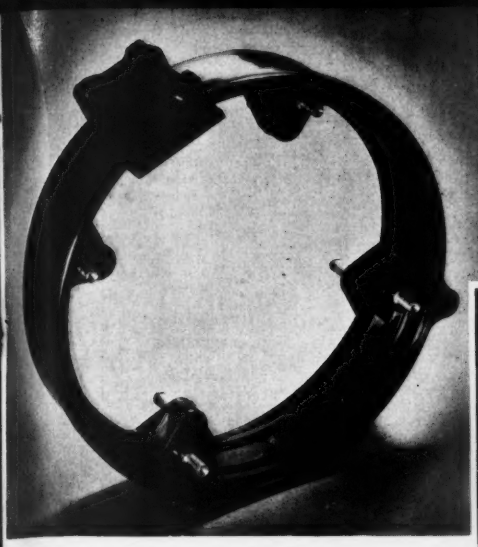
(Above) "Texolex KZ" end washer for switchgear—a macerated resin-fabric moulding by The Bushing Co., Ltd., for A. Reyrolle and Co., Ltd.

(Below) Brass-lined bobbin, fabricated from paper-base synthetic resin bonded tube and sheet by Mica Products, Ltd.

(Right) Electrostatic voltmeter with "Tufnol" insulators, top plate, and nameplate. (Courtesy, Tufnol, Ltd.)

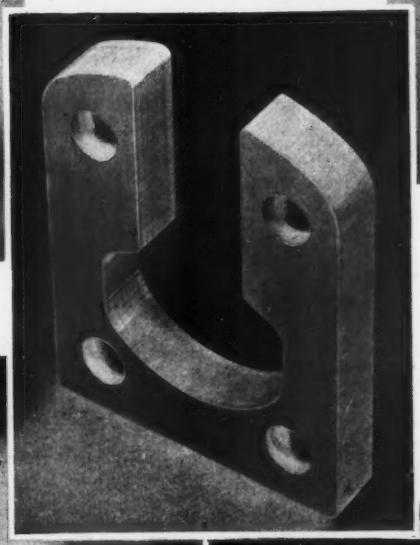
(Below) Group of moulded "Panilax" resin components of high voltage insulation assemblies, by The Micanite and Insulators Co., Ltd.

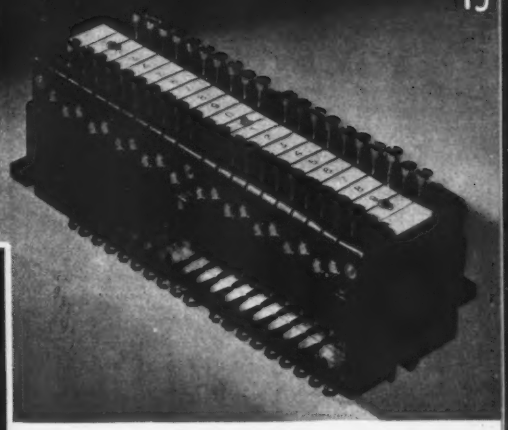




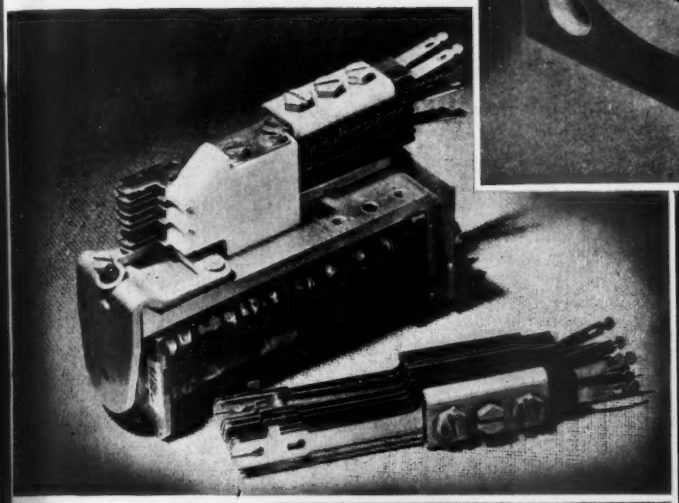
(Above) Motor suspension ring for vacuum cleaner, for Electrolux, Ltd., by The Phœnix Telephone and Electric Works Ltd.

(Below) Part of an oil switch arc-control device, in "Panilax" laminated, by The Micanite and Insulators Co., Ltd.





(Above) This G.P.O. terminal strip incorporates four main moulded components from phenolic material. In addition to moulding these components, The Streetly Manufacturing Co., Ltd., assembles the complete strips. A conveyor-belt system is used; no fewer than 140 separate parts are assembled by 21 operatives, who perform the 28 finishing operations, and every component is inspected twice during assembly. The terminal strip is protected by B.P. 20193/44. (Photograph published by permission of Engineer-in-Chief, Post Office Engineering Dept.)



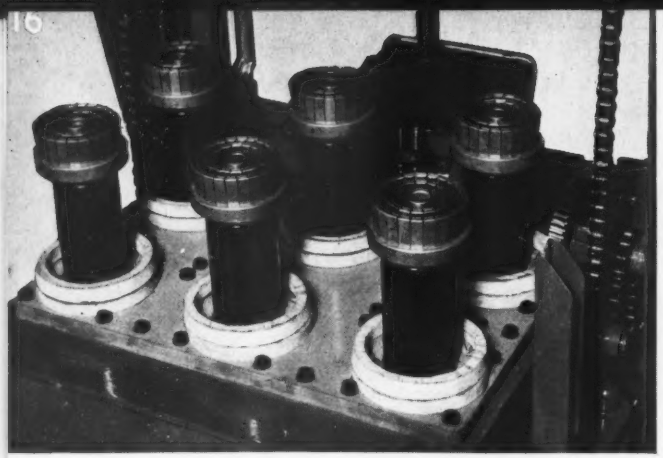
(Above) This G.E.C. telephone relay has one spring-set removed to show the white buffer block, moulded in "Beetle." (Courtesy, B.I.P. Ltd. and The General Electric Co., Ltd.)

(Above) Single and double lamp sockets (with wiring inserts) for British Railways, by Crystalate, Ltd.

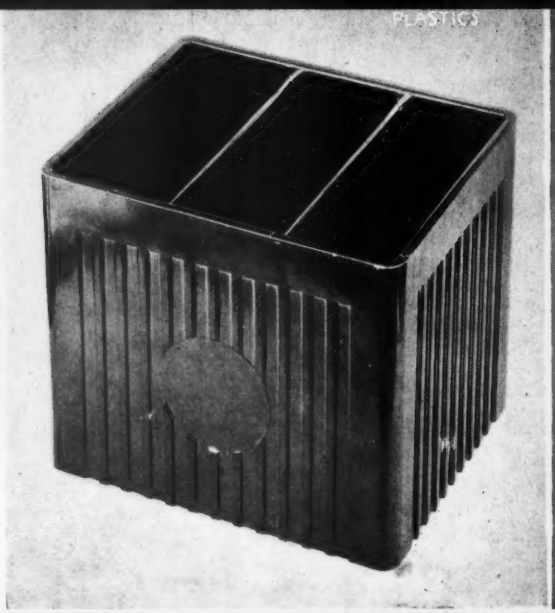
(Left) "Tufnol" bell insulator for supporting the overhead conductors on coke-oven plant. (Courtesy, Tufnol, Ltd.)

(Below) "Welvic" covered cables as made by Duratube and Wire Ltd. (Courtesy, I.C.I. Plastics Division.)

(Below) Miner's safety-cap lamp, moulded in shockproof phenolic material by British Moulded Plastics, Ltd., for Concordia Electric Safety Lamp Co., Ltd.

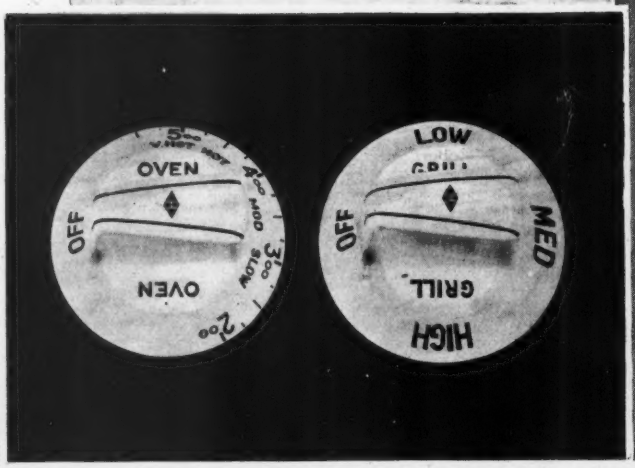


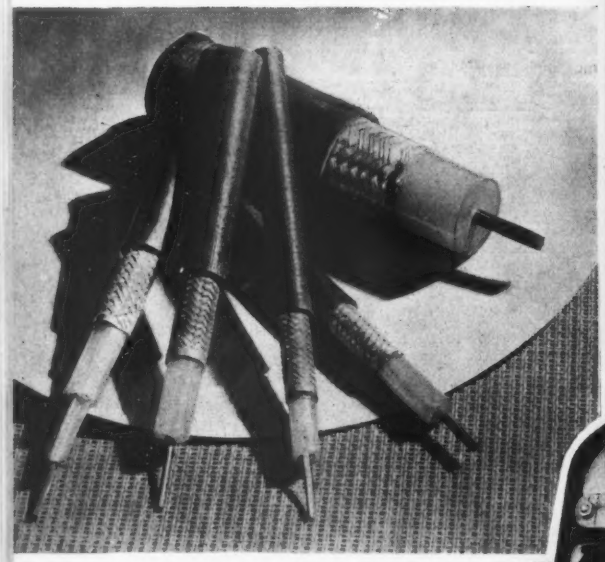
(Above) "Tufnol" insulators on an "Ellison" 1,200 amp. high voltage circuit breaker. (Courtesy, Tufnol, Ltd.)



(Upper, right) Large type battery box, moulded in phenolic by Robert McArd and Co., Ltd.

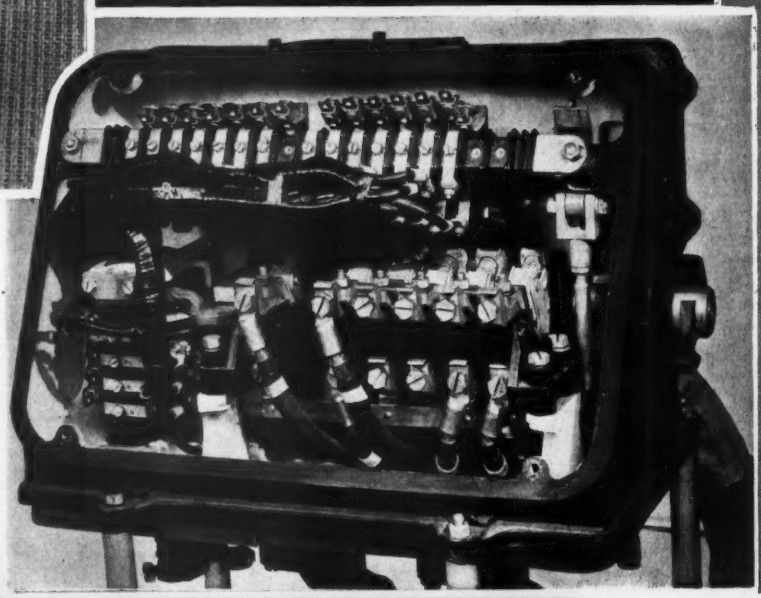
(Lower, right) Cooker dials by Ebonestos Industries, Ltd.

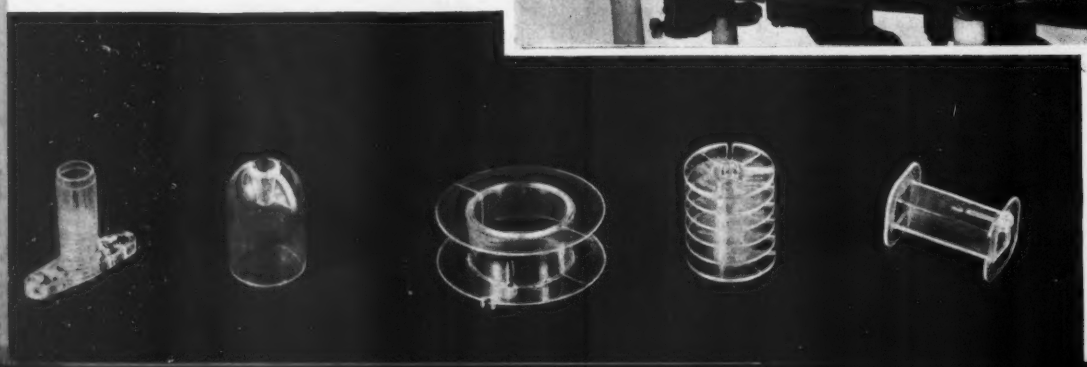




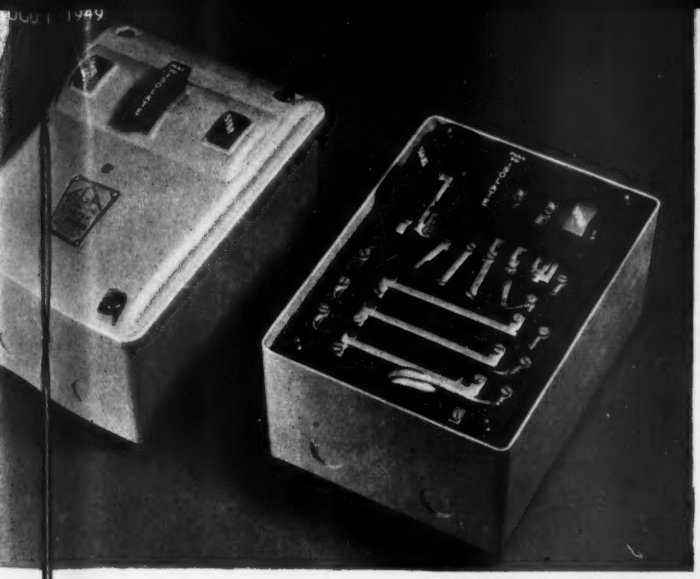
(Above) "Welvic" and "Alkathene" covered cables as made by The Telegraph Construction and Maintenance Co., Ltd. (Courtesy, I.C.I. Plastics Division.)

(Right) Three different grades of "Bakelite" moulding material are used in the production of this trolley-bus master control unit of The English Electric Co., Ltd. The moving contact arm is of high dielectric material, the cams of high impact strength material, and the reverser finger board of shock-resistant material. (Courtesy, Bakelite, Ltd.)

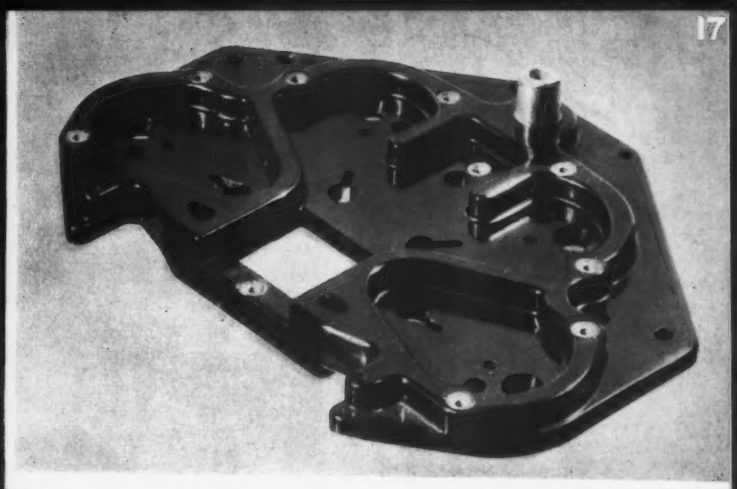




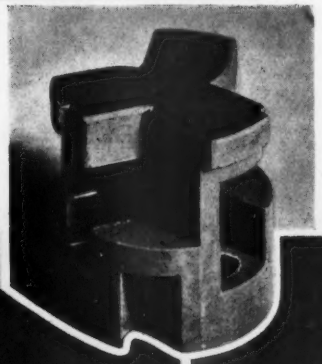
(Left) Injection mouldings for th... right: Iron core former in polys... for Transradio Ltd.; electric clo... polystyrene, for Simmons...



Above) ug-in-motor control switch for Ega Electric, td., sh n complete and with cover removed, the ulded parts by Moulded Products, Ltd.



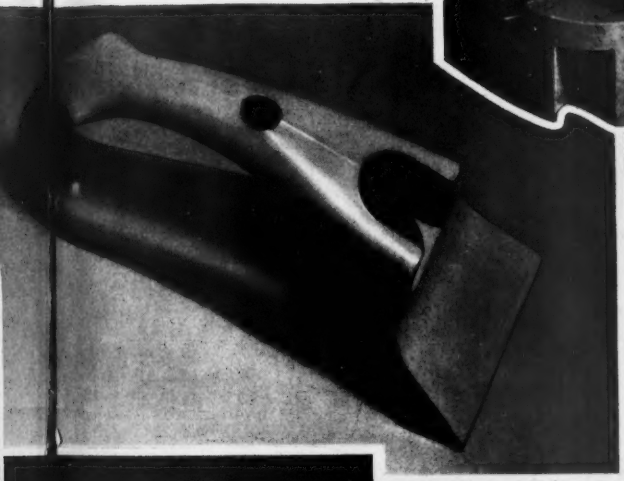
(Above) Thermosetting moulding by Joseph Lucas, Ltd. (Courtesy, I.C.I. Plastics Division.)



(Left) Interior for "Eas go" socket, moulded in melamine by Lustroid, Ltd., for A. Reyrolle and Co., Ltd.

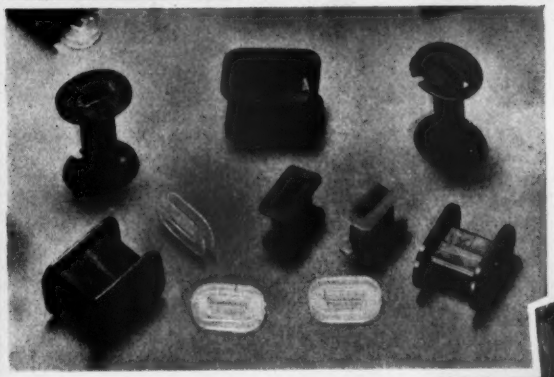
Below ravelling iron handle in red urea by Robert icArd and Co., Ltd.

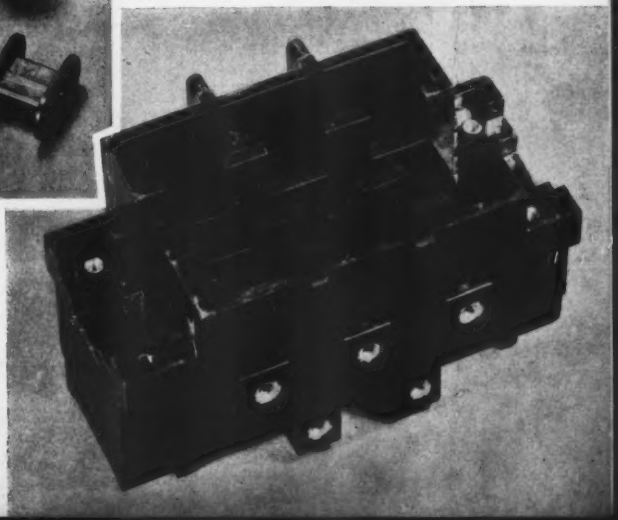
(Below) "Texolex KY" socket for mining switchgear, a macerated resin fabric moulding, produced specially for Victor Products (Wallsend) Ltd., by The Bushing Co. Ltd., and "Texolex KY" plug, a macerated resin fabric moulding for mining switchgear, also for Victor Products (Wallsend) Ltd., by The Bushing Co., Ltd.



(Left) Variety in bobbins, by Injection Moulders, Ltd.

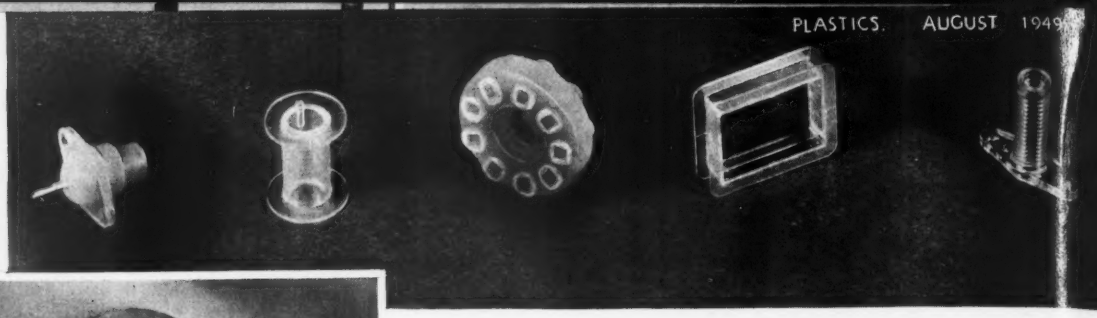
(Below) Contact switch in "Bakelite," by Ebonestos Industries, Ltd.



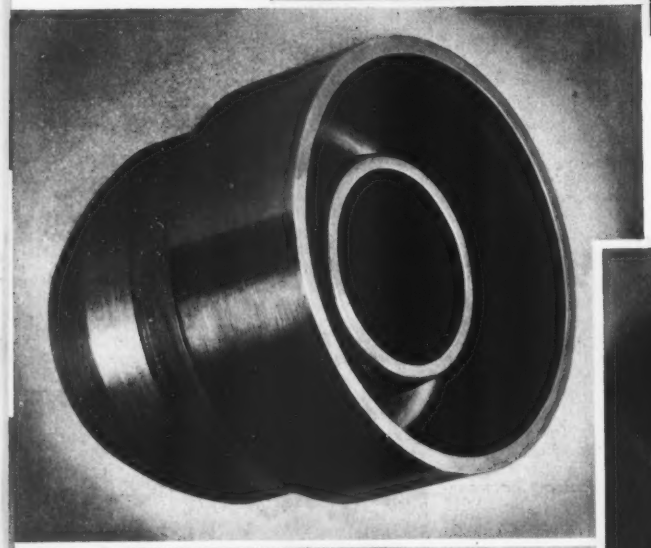


(Al) Flexible microphone cover, as used for alkie-talkie," moulded in p.v.c. by J. F. Kenure, Ltd.

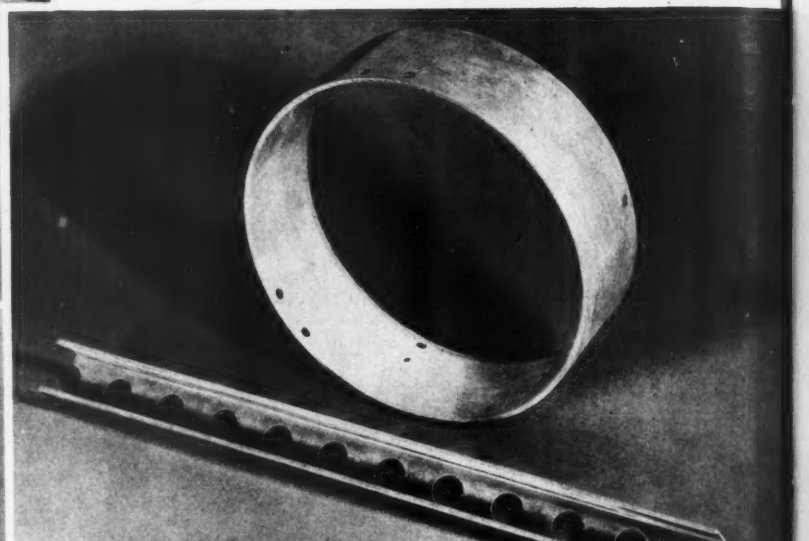
s for th ctrical industry, by Punfield and Barstow (Mouldings) Ltd. From left to n poly ne, fo Neosid Ltd., Welwyn Garden City; insulating bead in polystyrene ric clo obbin n polystyrene, for S. Smith and Sons, Cricklewood; coil former in mmon eroce sories Ltd.; another electric clock bobbin in polystyrene.

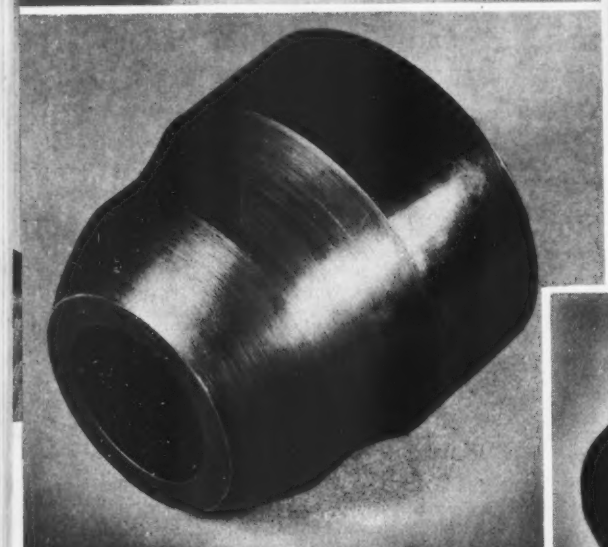


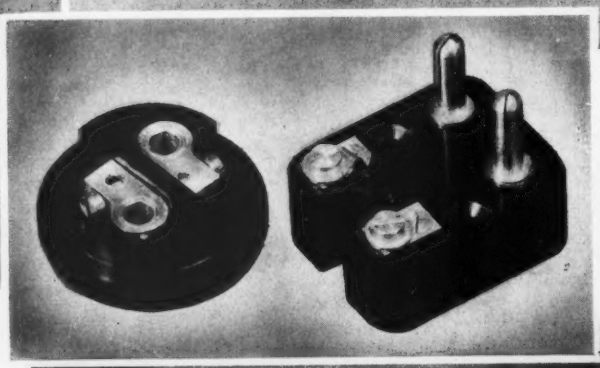
(Below) Moulded "Panilax" resin component (two views) for high voltage insulation assembly, by The Micanite and Insulators Co., Ltd.



(Above) Injection mouldings for the electrical industry by Punfield and Barstow (Mouldings) Ltd. From left to right: plug body in "Alkathene," for Paton Ltd.; electric clock bobbin in polystyrene, for S. Smith and Sons, Cricklewood; valve holder in "Alkathene," for Pye Radio Ltd.; coil former in polystyrene, for Decca Navigator Ltd.; iron core former in polystyrene, for Neosid Ltd., Welwyn Garden City.





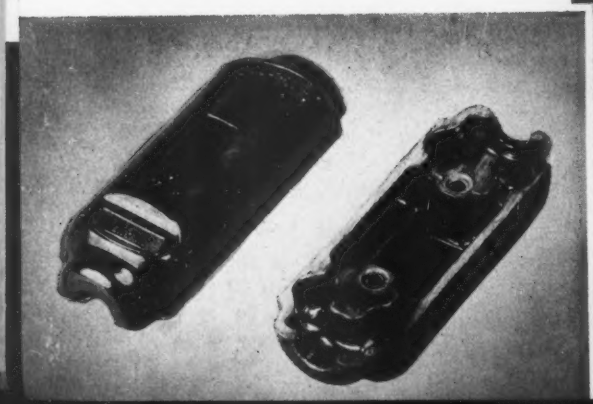


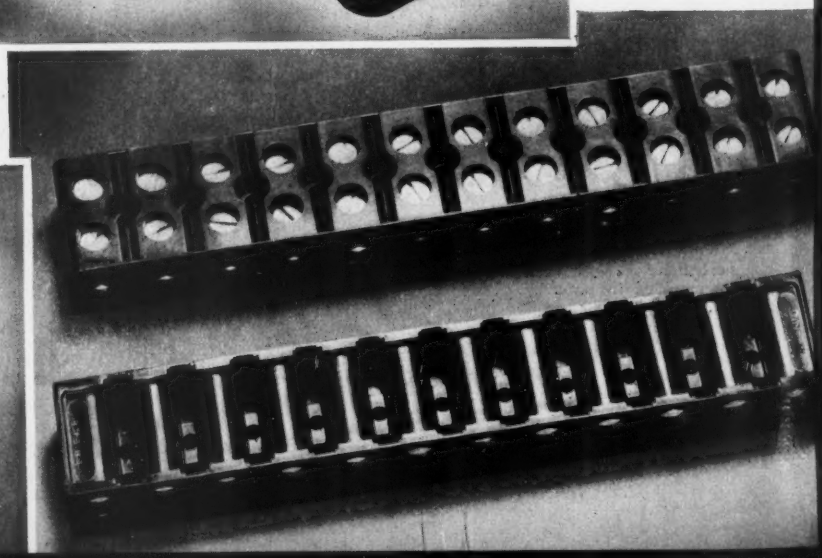
(Above) Coil ring, 9-in. diameter, in laminated synthetic resin-bonded paper tube, and wiring duct in asbestos heat-resisting material for aircraft, both by Mica Products, Ltd.

(Below) Special 12-way phenolic terminal block by Insulators Ltd.

(Right) Electrical connectors, by Crystalate, Ltd.

(Below) Special switch, moulded in "Bakelite," by Ebonestos Industries, Ltd.





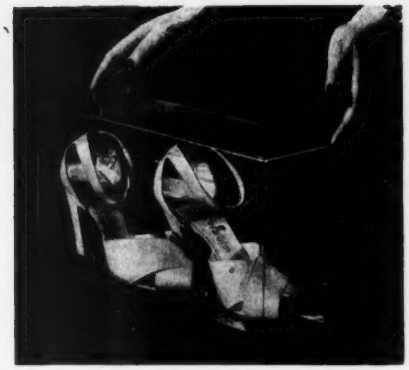


Fig. 1.—Acetate showroom box for displaying shoes. (Courtesy, Monsanto Chemical Co., U.S.A.)

Fig. 2.—Circular acetate container for sweets and nuts. (Courtesy, Eastman-Kodak Co., U.S.A.)

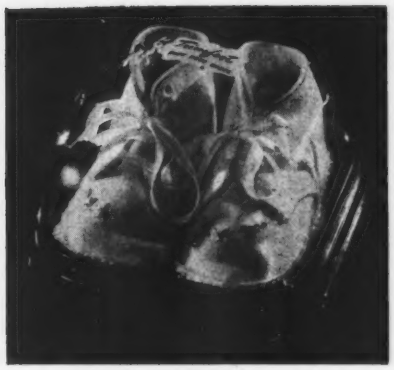


Fig. 3.—Acetate-covered display box for baby shoes. (Courtesy, Monsanto Chemical Co., U.S.A.)

Cellulose Acetate Plastics

XXIV—Further Applications

By VIVIAN STANNETT

LAMINATED cellulose acetate sheets and their applications were discussed in the previous part of this series. It is now proposed to deal with some of the applications of straight acetate sheeting and film. The most important of these at the moment is undoubtedly for rigid transparent packaging. This is the chief outlet for 0.005 to 0.015-in. sheet and film, and, indeed, at the present time seems to represent the only real hope of a massive sales outlet for this material. The consumption of cellulose acetate for this purpose is already very large in the United States, and is growing steadily.

The mass-production methods of container fabrication described earlier in this series[1, 2] have opened the way for the reduction in prices necessary to bring about their use for most medium-low to high price articles which benefit from being seen although packed. This latter category comprises widely different articles ranging from fruit and nuts, to men's braces and babies' slippers. Where a completely transparent container is not necessary, a cardboard or metal container with a transparent cellulose acetate window can be used. For example, the familiar round boxes of Swiss cheeses, which used to be made completely from cardboard before the war, are now often fabricated with the whole of the top part covered by a disc of transparent cellulose acetate sheet. This use alone represents a considerable tonnage of sheet consumed each year.

Other regular uses for transparent containers are for sweets, chocolates, nuts, etc., and for all kinds of pharmaceutical and toilet articles such as soap, hairbrushes, toothbrushes, towels, handkerchiefs and powderpuffs, as well as for many small articles of clothing and accessories including braces, belts, suspenders, neckties, gloves, flowers, costume jewellery and nylon stockings. The growing use of the "help yourself" and "supermarket" type of stores, particularly in the United States and Canada, also leads naturally to an increased need for transparent packing, including, of course, cellulose acetate containers.

The use of rigid transparent containers for many articles has led to a big increase in sales, particularly of the so-called impulse, i.e., unpremeditated buying, which accounts for a big percentage of all sales in any case. Increases up to 80 per cent. in impulse buying have been noted for some items in New York stores. Gift sales have also been found to increase by the use of good quality transparent packing, and utilitarian items such as hand towels properly packed in a transparent container make up into an extremely attractive gift. Many other goods usually regarded as more practical than attractive can also be made up into gift packs of most decorative appearance, resulting in a corresponding increase in sales.

In addition to their sales appeal, cellulose acetate containers have definite functional advantages. They are dust-proof,

Fig. 4.—Transparent acetate container for corsage decoration. Courtesy, Eastman-Kodak Co., U.S.A.)

Fig. 5.—Acetate-covered display box for gift goods. (Courtesy, Eastman-Kodak Co., U.S.A.)

Fig. 6—Various designs in lampshades made from cellulose acetate sheet. (Courtesy, Utilex Ltd.)

very strong if properly made and designed, light in weight, and available in a limitless number of shapes and sizes. Although most users prefer plain, colourless transparent acetate, for some purposes amber and other colours, including translucent, are used. The permeability of cellulose acetate to oxygen, moisture and other vapours make it an ideal material for packaging such items as flowers and fruit and vegetables. For similar reasons it has proved very suitable for cigar containers.

The tendency in the United States is to mass-produce these rigid, transparent containers in a very large number of standard sizes, but without too much regard for detailed quality, for example, with respect to seam. In Britain, on the other hand, the boxes produced appear to be rather better in quality, but tend to be made in too small a quantity to bring the price down to a competitive level. There is no doubt, however, that both these tendencies will be corrected with time.

Lampshades

Another steady outlet for cellulose acetate sheeting of 0.005 to 0.015 in. thickness is for the manufacture of lampshades. Acetate sheet is an ideal material for this purpose since it is light in weight, washable, of a suitably low degree of inflammability, and available in a complete range of tints and light transmissions from transparent to completely opaque. In addition, it is readily cut, punched, sewn and cemented.

A large number of ways of making acetate lampshades have been developed, including a few rather odd methods! The usual technique, however, largely follows the parchment and cloth methods in employing a wire-frame, around which the acetate, which has been previously cut or stamped out in the correct shape, is wrapped and sewn onto the framework; or the edges are punched and then bound on using a decorative binding material. The overlaps of the shade, for example, in the case of a simple truncated cone shape, can be sewn together or cemented or, more recently,[3] high-frequency welding can be used. The development of the most efficient mass production methods of joining the acetate together and to the frame, bearing in mind the appearance of the finished article, is one of the keys to the successful economic production of lampshades in what is now considered to be a highly competitive industry.

A very successful American innovation is an acetate sheet folded back on itself repeatedly across a narrow width, as for a fan. This sheet has a natural tendency to return to the folded state when stretched and thus, when cut and cemented, it falls naturally into shape across a conical or otherwise curved frame. Furthermore, the folds lend a very attractive appearance to the shade itself. The top and bottom edges of shades can be decorated either by sewing or by cementing a rayon or other type of coloured braid binding all around them. The surface finish which is preferred for acetate shades (Fig. 6) is either an even matt or a simple embossed sheet.

In addition to the wire-frame types, designs of inverted bowl shades can be made from acetate of a similar appearance to those made from glass, but much lighter in weight. These can be made by a simple shallow moulding operation using one of the methods described earlier in this series. For large bowls rather thicker material, e.g., 0.020 in. thickness, is used, owing to the considerable loss in thickness which may occur during forming and also the large areas of strain involved. To lend strength to such a structure, it is usual to mould one or more circular ridges into the bowl. The edges of the bowl are sewn or moulded round a supporting metal ring, which also carries the suspension cords.

Many manufacturers prefer to use light pastel colours for their shades. Others prefer to add further decoration and colour, employing a white or ivory acetate sheet as the background. Simple repeating all-over designs, such as fleurs-de-lis or polka dots, can be printed or silk-screened on to the sheet prior to cutting and assembling. More elaborate designs can also be silk-screened on to the uncut sheets in such a way that the subsequent stamping or cutting out of the blanks picks up the design correctly located in position. Another simple method of decoration either of the shade or the blank consists in using a stencil with a brush or spray gun, in conjunction with a suitable lacquer. Finally, the use of paint transfers also yields an attractive finish, although perhaps less adapted to mass production than the other techniques described.

Electrical Uses

Cellulose acetate plastics have good electrical insulating properties, as shown by the figures given in Table 1. Unfortunately, these values are somewhat adversely affected by the presence of excess moisture. Thin tapes cut from cellulose acetate film can be used for primary wire insulation; the windings are then cemented and sealed into place using a solvent cement, thus homogenizing the insulation. This avoids any disintegration or escape through the bond, such as can occur when varnished tapes, etc., are used. To give better moisture resistance, high acetyl cellulose acetate or cellulose acetobutyrate are preferred for primary wire insulation. Cellulose acetate and acetobutyrate sheeting have also been used as a dielectric in condensers and for insulation between layers of multiple-wound coils.

Extruded tubes of cellulose acetate are employed for insula-

Table 1.—Electrical Properties of Cellulose Acetate (Courtesy, Hercules Powder Co.)

	Sheeting	Moulding
Volume resistivity, ohm/cm., at 50% relative humidity and 25°C	$(0.7\text{-}1.4) \times 10^{13}$	$(5\text{-}30) \times 10^{13}$
Dielectric strength, volts/mil., ½ inch film	350-900	800-2,500
Dielectric constant, 60 cycle	3.5-6.4	3.5-7.5
Dielectric constant, 10^3 cycle	3.5-6.4	3.5-7.0
Dielectric constant, 10^6 cycle	3.2-6.2	3.0-5.0
Power factor, 60 cycle	0.01-0.06	0.02-0.07
Power factor, 10^3 cycle	0.01-0.06	— —
Power factor, 10^6 cycle	0.01-0.05	.004-0.09

Fig. 7.—This safety face-mask for sports wear provides a novel use for transparent cellulose acetate sheet. (Courtesy, Eastman-Kodak Co., U.S.A.)

ting the handles of tools for electrical applications, such as pliers. These can either be driven on to the handle directly or, more usually, softened by heat or softening solution and then pushed on.

Optical Uses

The non-inflammable nature of cellulose acetate, combined with its excellent transparency, has led to a number of simple optical applications. The windows of the familiar civilian gas masks during the war were made from 0.010-in. thick cellulose acetate. Another wartime use was for the side screens of Service motor vehicles, a use which has continued to-day to some extent for both Service and civilian vehicles. Similar uses are for motorcycle windshields, and for face masks as used in sport; also a number of industrial applications. Coloured, transparent acetate is now extensively used for sun-glasses, either in the form of the eyepieces cemented into frames, or by shaping directly from 0.015-0.020-in. sheeting, and with side slots cut to carry the side pieces.

A useful form of industrial safety goggles is made with rubber frames into which can be clipped a whole range of coloured acetate eyepieces, according to the purpose for which they are to be used, for example, blue for acetylene welding, etc. More unusual are specially designed[4] opaque glasses, which are used to cover the eyes while sleeping in daylight or for sun bathing. This type of glasses is also made with small tinted glass lenses inserted into the centre of otherwise opaque eyepieces for therapeutic purposes. Eyeshields for tennis and other uses where protection is needed are now made from acetate film, usually of a special green tint.

A further optical application of cellulose acetate film is for cinema and theatrical spotlights. For this use, a 0.010-in. thick transparent film is employed of a specially formulated non-inflammable grade in order to conform to the fire regulations. Also, because of the heat developed near the spotlights, very heat- and light-fast dyes have to be used to bring about the rather intense colours which are required for this type of work.

Miscellaneous Uses

A large percentage of the tonnage of acetate sheet made each year is used in a multitude of smaller applications. Thick sheeting is used for the moulding of aircraft components, such as wing tips, fairings, pilot seats, cockpit covers, and dinghy stowage boxes, as well as for certain types of shallow mouldings, such as trays. Thinner film has found application in a specially corrugated form for such purposes as transparent internal screening panels and other light constructional work. Corrugated black film built up in a special way, by alternating the corrugations, to considerable thicknesses, has found much favour in Great Britain and elsewhere as a lightweight heat-insulating material (" Isoflex," a product of B.X. Plastics, Ltd.) for refrigerator cars, etc. An opaque white film is sometimes used for the manufacture of collars and cuffs for nurses' uniforms, where their washable and non-staining qualities are exploited.

Thicker sheet can also be used as the basis for manufacturing of such articles as toothbrush handles, penknife handles, hairbrush backs, spectacle frames, buttons, handbag frames, and umbrella handles. For spectacle frames, tortoise-shell and other mottle finished sheets are often employed. Handles and other articles cut from sheet are often engraved with flower or other designs; this is carried out by skilled craftsmen using high-speed revolving cutters.

Thin sheet has been used for plastic playing cards and gramophone records, but for these particular applications a rigid polyvinyl chloride copolymer has proved to be a very serious competitor. Clock and radio dial crystals are moulded from discs of 0.020 to 0.050-in. thick transparent acetate sheeting. Bookbinders use transparent acetate sheeting for the manufacture of spiral bindings for diaries, etc., and also use the sheeting for diary covers. Office equipment manufacturers employ large quantities of transparent acetate film for covering identification tags throughout their filing and card indexing systems. Very thin sheet, printed with a delicate lace design, is used for table doilies and for the edging of kitchen and bathroom shelves. Thin acetate tape is used for backing of adhesive " Scotch " tapes for special applications where viscose film is unsuitable.

Before going on to describe some of the applications of moulded and extruded products, two rather interesting applications of sheet will be described[5]—wooden-heel covering for women's shoes and the plastic covering of wooden toilet seats.

Heel Covering

Celluloid sheet has been used for many years for this purpose, but recent years have brought acetate sheet into competition for this application, particularly when its advan-

Fig. 8.—Great variety in the shape of cellulose acetate containers (seamed and seamless) is possible, as shown by this range. (Courtesy, Utilex Ltd.)

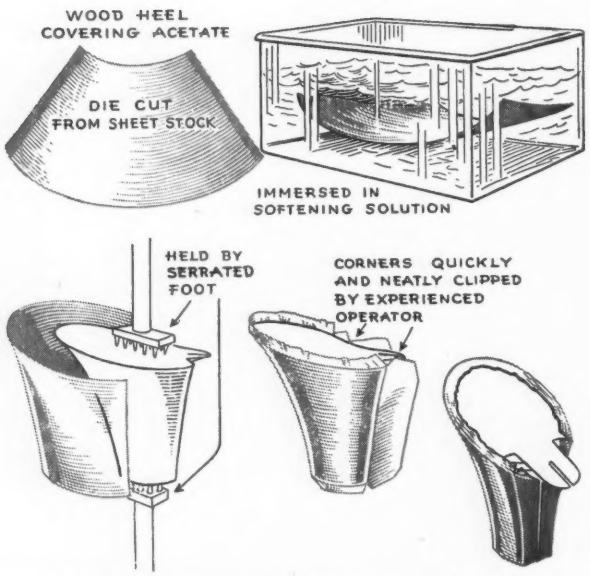


Fig. 9.—Cellulose acetate utilized as a covering for wooden heels. (Courtesy, Monsanto Chemical Co., U.S.A.)

tage of non-inflammability is taken into account. The actual covering is very skilled work.

The cover blanks are cut from acetate sheet of 0.010 to 0.025 in. thickness. The heavier grade is necessary when alligator or other deeply embossed designs are to be used. The blanks are then immersed in a softening solution until the material becomes quite limp. Twenty to fifty pieces are often softened at one time. The softened pieces are then kept on the work bench between cloths after removal from the solution. The wooden heels are clamped by means of special end pivot clamps and the curved surface is painted with a suitable acetate cement. The softened acetate blank is then wrapped and stretched quickly around the heel and the corners are clipped with scissors to enable a neat overlapping of the tops and bottoms. The overlaps are finally cemented by brush and the whole removed and left to dry.

Table 2.—Softening Solution for Cellulose Acetate (B.X. Plastics Ltd. [6] and [7].)

Toluol	100 parts by volume
Methylated spirit	100 parts by volume
Acetone	40 parts by volume
Water	5 parts by volume

Since drying causes the acetate to shrink, a firm and taut covering of the heel is obtained.

An excellent softening solution for work of this kind is the one recommended[6,7] by B.X. Plastics and given in Table 2. The schematic illustrations given in Fig. 9 show the essentials of the method.

Toilet Seat Covers

Sheeting of 0.010 in. thickness is used for toilet seat covers. The wooden seat is first carefully sandpapered and then coated with a suitable acetate cement. The cut blank of acetate sheet is immersed in softening solution until it is limp and then removed, wiped with a dry cloth and applied to the wooden seat, which should still be tacky with cement. The assembly is then pressed in a suitable press, using thick sponge rubber pads against the cellulose acetate side, and is left overnight to dry, after which it is trimmed down to size.

It is usual to cover each side of the seat separately, in which case it is best to cover the flat side first. When this has been done as described, the curved side is covered with the softened sheet, but in this case the assembly is removed from the press after a few minutes and the stretching is finished by hand. The overlapping edges are stretched round and cemented on to the flat surface. As in the process for heel covering, the shrinking of the sheet on drying ensures a permanent covering of good finish.

The methods used for wooden heel and toilet seat covering can be equally well adapted for the covering of any wooden article of simple shape.

REFERENCES :

(1) "*Plastics*" 1949/13/130. (2) "*Plastics*" 1949/13/183. (3) "*Plastics*" 1948/12/398. (4) "*Modern Plastics*" 1947/24/214. (5) *Monsanto Chemical Co., U.S.A., technical literature on "Fibestos."* (6) *B.X. Plastics Ltd., technical literature on "Bexoid."* (7) "*British Catalogue of Plastics*," 1947, p. 597.

Notes from the British Plastics Federation

Works Managers' Discussion Group

With a view to developing mutual aid in the moulding branch of the industry, a meeting of the Discussion Group of works managers, development managers and other technical personnel of member firms of the Federation is to be held at the Royal Hotel, Southport, Lancs, on October 10 and 11, 1949. An interesting agenda is being prepared and a number of members have already decided to send representatives to the meeting.

Chemical Plant

The Chemical Plant Sub-committee of the Extruders' Technical Committee has been set up to prepare a specification for p.v.c. and polythene tubes and for polythene sheeting for use in chemical plant. The P.V.C. Compounders' Technical Committee are co-operating by preparing a suitable specification for p.v.c. compound for this purpose.

Certification Mark

On the recommendation of the Federation the Plastics Mark Committee of the British Standards Institution have made a condition of licence for use of the Certification Mark on finished articles and components, to the effect that such articles must be manufactured from certified material. If there is yet no specification for the material the application will be considered on its merits.

Plastic Buttons

Complaints have been received from the Retail Trading Standards Association about plastic buttons, with particular regard to the bleeding of colour. On investigation it has been found that it is not the buttons that are at fault but the use of water-soluble dyes which are frequently used to match up particular dress materials. There are a number of plastics materials used for button manufacture which are entirely satisfactory in every respect.

Festival of Britain, 1951

A Discussion Group has been set up between the British Plastics Federation and the Council of Industrial Design concerning the use of plastics products in the 1951 Festival of Britain Exhibition. Its purpose is to ensure that products of new and improved design are brought to the notice of the authorities concerned with the organization of the Festival of Britain. The Group will also maintain close co-operation between the British Plastics Federation, the Council of Industrial Design, and the Festival authorities.

Moulding Powder Imports

Quantities of moulding powder imported each month from February to June, 1949, inclusive, were as follows:—

	Feb. (tons)	Mar. (tons)	Apr. (tons)
Cellulose acetate-butyrate	64	48	18
Ethyl cellulose	—	—	—
Urea-formaldehyde	3	—	—
Polystyrene	202	88	267

	May (tons)	June (tons)
Cellulose acetate-butyrate	80	6
Ethyl cellulose	—	—
Urea-formaldehyde	—	—
Polystyrene	247	122

These figures, in part, correct those which were published in "Plastics," July, 1949, page 377.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

GIANT POLYTHENE TUBES.—This length of what is possibly the largest thick-walled extruded polythene tubing in the world, 12 ins. diameter, is seen here being carefully protected with paper strips to prevent scoring or other damage in transit from the factory of the manufacturers, Tenaplas, Ltd., of Upper Basildon, Berks. Overseas manufacturers are increasingly attracted by the advantages of polythene pipes, notably their resistance to chemical attack and corrosion, their lightness and flexibility.

PLASTICIZER FOR U.F. PRODUCTS. Urea-formaldehyde adhesives for plywood and veneer board tend to be very brittle after they set. These adhesives are apparently quite difficult to plasticize and their use has been limited along the lines mentioned, for this reason. Coatings and impregnations of textiles, paper, etc., with urea-formaldehyde resins and compositions suffer from the same disadvantage. The incorporation of about 2 per cent. diglycol stearate S in such products plasticizes them effectively and prevents them from becoming brittle; the bonding action is not affected. Diglycol stearate S is a white wax-like product, having a slight agreeable fatty odour. It is made by the Glyco Products Co., Inc., Brooklyn, N.Y.

FACIA PANEL MANUFACTURE, an interesting development of the "Redux" bonding process, is the subject of Aero Research Technical Notes No. 77, issued by Aero Research, Ltd., Duxford, Cambridge. The technique employed is a relatively new one and in consequence has not yet found widespread use in the automobile industry. As it can be used successfully by relatively unskilled labour for the manufacture of dashboards, it should find many other applications. For many years the designers of car bodies have been looking for a facia panel which combines the distinctive appearance of wood with the strength and ease of fabrication of sheet metal, and it has now become normal practice to use veneered plywood or steel. Illustrations in the present Technical Notes show the various steps in applying walnut veneer to the pressed steel dashboard used for the 1949 Hillman "Minx." After the pressing is degreased, it is sanded, using a portable belt sander. The pressing is then jigged for application of "Redux" liquid resin through a fine, specially masked brass gauze. A second operator places the resin-coated pressing face downwards in a tray of "Redux" powder and removes surplus powder. In this way the two operators can prepare 80 pressings per hour ready for bonding, which is carried out in an hydraulic press fitted with steam-heated platens which run continuously at a temperature of 145 degrees C. Experience has shown that one operator can load the press with 14 dashboards and veneers, allow time for the resin to be cooled, and unload the press about once every 25 minutes. From a press with a platen area 6 ft. by 3 ft., there is an output of 280 facia panels every 8-hour day. After the bonding operation has been carried out, another operator merely cuts away the surplus veneer.

SYNTHETIC RUBBER NAME CHANGE.—It is announced by the Anglo-American Oil Co., Ltd., that in order to achieve world-wide uniformity, the name of the oil-resistant nitrile synthetic rubber currently marketed by them under the name "Perbunan" is changed to "Paracril," with effect immediately. Paracril is available in four grades. It is employed in all applications requiring a rubber combining good physical properties with outstanding resistance to oil and heat. In addition, it is an excellent non-volatile, non-extractable plasticizer for vinyl and phenolic resins.

SHELL CHEMICALS, LTD., inform us that reduced prices will apply to deliveries of the Shell solvents listed below, as from June 13, 1949, for 10-ton lots:—

	New Price per ton	Old Price per ton
Methyl ethyl ketone ...	£100	£105
Methyl isobutyl ketone ...	£140	£160
Secondary butyl alcohol...	£120	£138
Methyl isobutyl carbinol	£145	£154

AUSTRALIAN VISITOR.—We learn that a representative of Robert Bryce and Co. Pty. Ltd., of Australia, will arrive in this country at the end of August, being interested in equipment for the plastics industry, particularly injection moulding presses and timing devices. Those interested in exporting to the Australian market should send communications to Robert Bryce and Co. Pty. Ltd., 62, Finsbury Pavement, London, E.C.2.

REDIFFUSION LTD. inform us that the company's name was changed to Redifon Ltd. as from July 1, 1949. "Redifon" has always been their registered trade mark, and has during the past few years been very closely identified with the company's products. The name "Rediffusion," on the other hand, was originally applied to the system of wire broadcasting operated on a very wide scale in this country and overseas by the Broadcast Relay Group of Companies, and has become very closely identified with that system. It is, therefore, felt that since the company's own main business is the manufacture and world-wide sale of radio communication equipment, industrial radio frequency heaters and allied products, this change of name will be appropriate and more in keeping with their activities.

BRITISH INDUSTRIAL PLASTICS, LTD.—To mark the celebration of their Jubilee (1894-1944), referred to elsewhere in this issue of "Plastics," a history of the B.I.P. and its subsidiary companies has just been published under the title "Growth of a Group." It is well printed, and illustrated throughout its 49 pages. Mr. Kenneth M. Chance, who has been chairman of B.I.P., Ltd., since 1933, contributes a "Foreword."

MILTOID, LTD., cellulose nitrate, acetate and kindred material merchants, 34-36, Royal College Street, London, N.W.1, advise us that the company is now operating under entirely new management. Their range of stocks will be increased to include cellulose nitrate and acetate (non-flam) in sheet form. Their new telephone number is Euston 6467.

CHILTERN PAPER PRODUCTS, LTD., Hemel Hempstead, Herts, have now moved into their London showrooms and sales offices at 16, Curzon Street, London, W.1 (Telephone: Grosvenor 3364/5), where all inquiries can be dealt with. The company's main products are cellulose acetate containers and fibreboard drums.

AIRFIX PRODUCTS LTD. inform us that Mr. A. J. Dolan, works manager, has left the company.

SCOTTISH MOULDING CO., LTD., 33, West Savile Terrace, Edinburgh, has been taken over by Technoplastics, Ltd., Montrose Avenue, Hillington, Glasgow, as from July 2, 1949.

P.I.G.S.—The London Section of the Plastics Industry Golfing Society held their 4th meeting on July 12 at Walton Heath Golf Club, Surrey, when 45 members and guests attended. For "F. A. Hughes's" trophy—winner: D. Sullivan (De La Rue Extrusions, Ltd.) 91, less 14, net 77; runner-up: J. T. Hyde (Hyde Plastics, Ltd.) 93, less 16, net 77. D. Sullivan had best second 9-hole score. For "Cyril Last" and "Major Knowles" trophies (Greensome bogey)—winners: J. M. Davie (The Hadley Co., Ltd.) and H. H. Woolveridge (British Resin Products, Ltd.), both 3 up; runners-up: D. Watkins (Powell Duffryn (Air), Ltd.) and C. H. Appleby (British Artid Plastics, Ltd.), both two up.

The North Western Section held their 3rd meeting on July 3, at St. Ann's Old Links. For "Mouldrite" trophy—winner: J. H. Redfern (May and Baker, Ltd.) 81, less 8, net 73; runners-up: J. K. Luke (Bakelite, Ltd.) 94, less 18, net 76, and J. Lewis (Ferranti, Ltd.) 84, less 8, net 76.

The September outing of the N.W. Section is to be held over Prestbury and Upton Golf Course, near Macclesfield, on Thursday, September 29, when the Partridge Trophy will be up for competition.

The Midlands section held their 2nd meeting on July 14, at Blackwell, Worcs. For "Bakelite" trophy—winner, A. S. Faulkner (Bakelite, Ltd.); handicap 14, one up on Bogey; runner-up, W. S. Dale (Bakelite, Ltd.), handicap 2, all square.

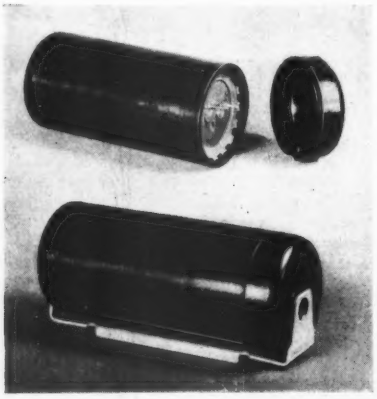
New Productions in Plastics

Carrying Hard-boiled Eggs

This novel form of container for carrying four hard-boiled eggs on picnicking and similar occasions is moulded in polystyrene by Stone and Simmons, 73-75, Mortimer Street, London, W.1. It is light in weight and easy to keep clean. Salt for use with the eggs is carried in a specially moulded compartment centrally placed in one half of the moulding. This compartment is fitted with a transparent cap, so that it is easy to tell at a glance when refilling is necessary.

Capacitor Case

The motor-start capacitor shown below is manufactured by the British Electrolytic Condenser Co., Ltd., and is marketed by The Plessey Co., Ltd., of Ilford, Essex. It is provided with a moulded plastic case with a spring-clip mounting, which is fixed to the



top of the electric motor housing. The moulded case is neat and provides efficient insulation properties; it is of small dimensions compared with contemporary patterns which have a metal case. The spring clip facilitates installation or removal.

Child's Tea Set

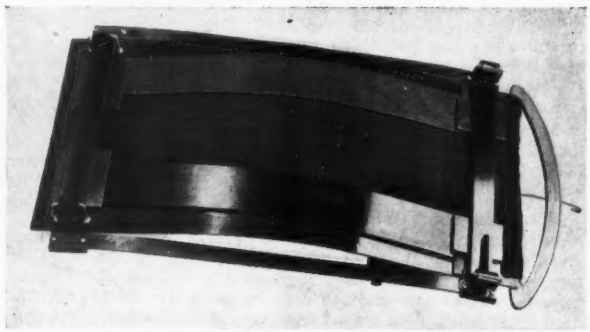
We saw this child's tea set at the B.I.F. It is of pale pink paper-filled urea, being one of the range of "Ellar" products of L. Rees and Co., Ltd., 31-35, Wilson Street, London, E.C.2. The moulders are Universal Metal Products, Ltd., Langley Road, Pendleton, Salford, Lancs.

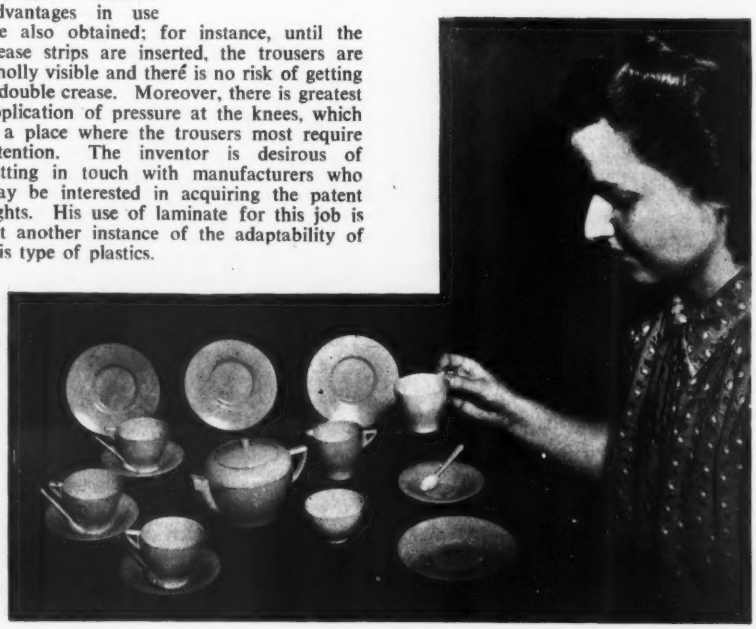
Laminate Applied to a Trouser Press

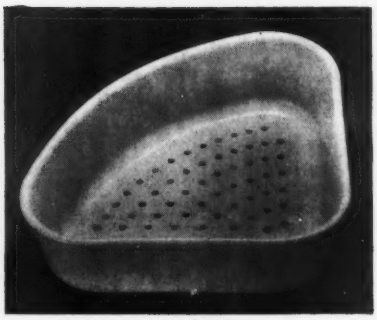
Due to present restrictions on the supply of steel and wood, the conventional-type trouser press is almost unobtainable. Considered aside from present-day circumstances, however, the old-type press was cumbersome and most men found it too much trouble to use; the steel threads rusted and squeaked, and double creases in the trousers were often the result of failure to manipulate the press efficiently.

The trouser press which we illustrate (B.P. 583,660) is made almost entirely of laminate plastic sheet. It has been patented by Mr. F. G. Fletcher, 34, Cheyne Walk, Grange Park, London, N.21, who brought one to this office to demonstrate its good points. Incidentally, it had previously been given a televised demonstration by the B.B.C. Television "Inventors' Club."

Compared with the conventional wood and steel press, the new laminate construction is lighter in weight by 50 per cent. Trousers can be inserted in 20 seconds, and removed in three seconds. Other advantages in use are also obtained; for instance, until the crease strips are inserted, the trousers are wholly visible and there is no risk of getting a double crease. Moreover, there is greatest application of pressure at the knees, which is a place where the trousers most require attention. The inventor is desirous of getting in touch with manufacturers who may be interested in acquiring the patent rights. His use of laminate for this job is yet another instance of the adaptability of this type of plastics.







Kitchen Sink-tidy

A sensible sink-tidy is that moulded by Godfrey Holmes (Plastics), Ltd., of Wragby, Lincoln. It is of polythene and therefore quite unbreakable; nor will crockery break if dropped on to it. It is thus the perfect replacement for the usual enamelled iron or aluminium type on the market. Obviously it is unattacked by anything in the form of food and food liquids with which it comes into contact. Sensibly the maker has moulded into it the words: "Do not use with boiling water." Finally, three studs which are moulded in the base raise it sufficiently to allow liquids to drain rapidly away.

General view of works of The Streetly Manufacturing Co., Ltd., at Streetly, near Birmingham.

B.I.P. Celebrate Their Jubilee (1894-1944)

THE B.I.P. Group, as we know it to-day, is almost a unique organization in world plastics: it is a vertical trust, whose subsidiaries are engaged in every branch of production of amino plastics. The parent company (British Industrial Plastics, Ltd.) makes the raw materials; one subsidiary (B.I.P. Tools, Ltd.) makes steel moulds, tools and dies for the plastics industry; and another subsidiary (The Streetly Manufacturing Co., Ltd.) uses the products of the other two to produce trade mouldings and proprietary lines, in urea, melamine and thermoplastic materials, including the well-known "Beetleware." The Beetle Products Co., Ltd., is the selling company for "Beetle" and "Scarab" urea and "Beetle" melamine moulding powders, also resins for industrial use, while Beetle Bond, Ltd., is the selling company for adhesives and foundry core-binding resins. To these activities is to be added shortly a further subsidiary to make automatic moulding presses.

Mr. Kenneth M. Chance, chairman of B.I.P. Ltd., who retires from the managing directorship.

The Group has many interests outside the plastics moulding business. It makes textile resins for producing crease-resistant finishes, for controlling shrinkage in cotton and rayon and wool, for finishing lace and net, and for pigment fixation. It makes adhesives for wood, used widely in plywood manufacture, in boat and aircraft construction, and wherever strong, durable water-resistant joints are required. It makes resins for up-grading the wet strength of paper; resins for binding foundry sand cores; and resins for bonding moulded pulp.

This versatile service in amino plastics evolved from small beginnings. The Group has grown out of The British Cyanides Co., Ltd., formed in 1894 by two well-known Midlands chemical manufacturers, Albright and Wilson, Ltd., and Chance and Hunt, Ltd.

Its early period was one of frustration. The year 1925, however, was the turning point in the Company's history, for that year "Beetle" resin was invented by Rossiter, the Company's chief chemist. By 1936 the Company was so well launched in the plastics industry that the name was changed to British Industrial Plastics, Ltd.

The Group's outstanding achievement has been its service in World War II. A special new adhesive, Beetle Cement "A," evolved by the Company's chemists and patented, was specifically designed for aircraft manufacturers and constructional woodworkers. Beetle adhesives were used in the construction of assault craft, pontoons and safety rafts; of M.T.B.s, aircraft fuel jettison tanks, and for many other uses.

At the Streetly moulding factory enormous quantities of moulded components were produced in various plastics materials. At the Tyburn Road toolroom, Erdington, Birmingham, in addition to the high-quality moulds to Service specifications, there were produced diverse products ranging from large drilling jigs used in aircraft fuselage manufacture to small radio valve pins.

Actually, the Company's Jubilee fell in 1944, but because of the war the celebration was postponed. Indicative of the post-war progress made is the announcement this year of the invention of a new moulding powder; a more accurate and very much quicker method of producing moulds and mould parts by precision casting, rather than by machining; an improved method of heating moulds by the incorporation within them of induction heating coils; and the automatic moulding machines already mentioned.

Coincidentally with this Jubilee celebration of the Company there occurs a change in management. Mr. Kenneth M. Chance, chairman and managing director, retains his chairmanship, but retires from the managing directorship, a post he has held for 43 years. His successor is Mr. Charles H. Glassey, who has been with the Company since 1907 and a director since 1937.

Mr. Charles H. Glassey, who succeeds Mr. Chance as managing director of B.I.P. Ltd.

The Search for New Plasticizers

A GOOD deal of research is now being directed towards the discovery of new plasticizers which overcome some of the disadvantages inherent in the recognized and highly appraised groups; also to the development of cheaper plasticizers which can be used to replace some or all of the plasticizer content, which may be as much as 50 per cent. of the total weight of the plastics materials.

There is no such substance as the perfect plasticizer; even the most successful plasticizer possesses certain weaknesses which may only become evident when the compound is needed for a specific purpose. Dioctyl phthalate possesses an extremely low volatility, together with wide compatibility, low water extraction, excellent light and heat stability, low toxicity and resistance to hydrolysis; indeed, it may claim to be the most successful and important plasticizer in general use. Yet dioctyl phthalate is unsuitable for use where a reasonably high degree of flame resistance is needed, e.g., in calendered p.v.c. sheeting to be used for curtains, rainwear, dress covers, etc. For flame resistance it is necessary to use one of the phosphate plasticizers, such as tricresyl phosphate, but this has to be done with a sacrifice in plasticizing efficiency, and as a class the phosphates are generally suspect where non-toxicity is specified.

Subsidiary Requirements of a Plasticizer

Apart from plasticizing efficiency, a new plasticizer must be able to fulfil certain subsidiary but very necessary requirements, the most important of which can be summarized as follows:—

(1) A high degree of compatibility or miscibility is essential, otherwise the plasticizer will "sweat-out" of the plastics composition or show as a bloom on the surface. These defects are serious, and they are liable to be particularly aggravated when the plastic is stored or used at sub-tropical or tropical temperatures. Compatibility can often be improved by using mixtures of plasticizers, e.g., some of the new fatty acid derivatives which show a tendency to migrate can be mixed with dioctyl phthalate, which exercises a restraining effect on plasticizer migration. Many manufacturers now favour the use of mixtures where a low cost plasticizer can be safely blended with more expensive non-migratory types.

(2) Plasticizing action must be permanent. This means that the plasticizer needs to possess a low volatility and to be immune from the leaching effect of water; moreover, its resistance to extraction by oil should be reasonably good and its chemical stability of a high order. This, of course, is asking a great deal, but the permanence of any plasticizer can often be improved by correct processing or compounding, and also by the blending of plasticizers of high permanency with cheaper compounds which may be considered to be less trustworthy. As permanency depends largely on the nature of the application, e.g., where a plasticized material comes in contact with oil or hydrocarbons which normally dissolve plasticizers, special plasticizers must be selected for these specific applications. The use of high molecular weight plasticizers, such as co-polymers of butadiene and acrylonitrile, which are able to resist extraction by oils and greases, enables p.v.c. films to be utilized for food packaging.

Low-temperature Flexibility

(3) Low-temperature flexibility is now required for many plastics, particularly films to be used for packaging foodstuffs. Generally speaking, the long, straight-chain aliphatic compounds are greatly superior to the aromatic compounds, and some of the newer plasticizers of the oil group based on azelaic acids are assuming importance, although they show a tendency to migrate and are best mixed with dioctyl phthalate.

(4) Odour, taste and toxicity of the plasticizer require very careful consideration, as many present-day applications of plastics depend on their ability to be safe to handle and use, even by children. By employing modifying agents, it is, of course, possible to mask offending odours, but the wisest course is to choose odourless plasticizers for applications where smells of any kind cannot be tolerated. Tasteless additions are very necessary for uses where the plastic comes in contact with foodstuffs, e.g., in packaging films, beer pipes and tableware, and for these the phthalates as a class are usually preferable to the phosphates. Toxicity has assumed increased importance during the past five years owing to the increased use of plastics in the home, and the realization that when in contact with foods, particularly oils and greases, there is usually some extraction of the plasticizers and contamination of the foodstuff. Those plasticizers of the oil group are probably the safest in present-day use.

(5) Inflammability, or at least a reasonable degree of flame resistance, is of vital importance in certain applications, and the aromatic phosphates and many chlorinated plasticizers are able to endow plastics compositions with good flame-extinguishing properties.

There are, of course, a number of other requirements, such as electrical insulation, which may be called for by manufacturers of certain types of plastics. Then there is the question of cost, which needs to be reviewed, and bearing in mind that the plasticizer content of a plastics article may be as much as 50 per cent. of its weight, it is important to consider all possible means of reducing the price of the plasticizer. The use of extenders, generally high boiling cyclic hydrocarbons, which can be blended with dioctyl phthalate, dibutyl phthalate or tricresyl phosphate, etc., brings about a substantial reduction in cost, but reduces plasticizing efficiency and permanence. On the other hand, some of the higher boiling members of the hydrocarbon group possess important electrical insulating properties and are sometimes useful for p.v.c. cable sheathing and other electrical extrusion products.

Overcoming Certain Weaknesses in Known Plasticizers

As it would be tedious to describe the large number of new plasticizers now becoming available, particular attention may be directed to those compounds which claim to overcome some of the weaknesses known to exist in conventional plasticizers, or which offer promise of being less expensive than D.O.P., T.C.P. and other well-known materials.

Considerable success has been achieved in the development of new non-toxic phosphates which possess low volatility, low-temperature flexibility, flame resistance, good light stability and resistance to embrittlement on prolonged exposure. An alkyl aryl phosphate is now being manufactured which is claimed to be quite outstanding in its departure from the usual phosphate plasticizers. It has a lower burning rate than any equally efficient plasticizer used in polyvinyl chloride films. Tests show that it "flames out" in one second flat, compared with the minimum burning rate of 38 seconds for other plasticizers having the same general characteristics. This alkyl aryl phosphate is one of the least toxic of all plasticizers, including the citrates which are normally recommended where intimate contact is made with foodstuffs. This quality of low toxicity makes this new phosphate suitable for vinyl hospital sheets, anatomical restorations, shoes, dentures, baby pants and other products which come into intimate contact with the human body. Other important properties are high compatibility with vinyl resins, permanence, good weathering characteristics and high strength. The use of this plasticizer is recommended for upholstery, floor covering materials, shoe soles, luggage covers, and cable sheathing. For all these applications the plasticizer imparts excellent elasticity and abrasion resistance to the polymeric substance.

The large scale synthesis of iso-octyl alcohol has led to the production of

di-iso-octyl phthalate, which, although comparable in every respect with dioctyl phthalate, promises to be cheaper. Di-iso-octyl phthalate is a primary plasticizer for most resins and imparts permanent flexibility, low-temperature flexibility, low water extraction, resistance to hydrolysis, a very good degree of ultra-violet light stability and excellent electrical properties. It has a slightly higher boiling point than dioctyl phthalate and the mid-boiling point at 4 mm. is 235 degrees C. The flash point of di-iso-octyl phthalate at 150 degrees C. is 0.05 mm. mercury and the plasticizer is insoluble in water at 25 degrees C., but completely soluble in petrol and mineral oil. Di-iso-octyl phthalate is insoluble or difficultly soluble in glycerine, glycols and some amines. It is soluble in most other organic liquids. The migration of the plasticizer is very slight.

Another new phthalate, very similar to dioctyl phthalate is dinonyl phthalate. When the Standard Oil Co.'s new plant is producing nonyl alcohol on a large scale the nonyl esters may be cheaper than the octyl esters and, in certain cases, even offer some slight technological advantages over the former. Dinonyl phthalate has a lower volatility than dioctyl phthalate. If compounds having the same amount of dinonyl phthalate and dioctyl phthalate are compared after "heat ageing," there is, in general, little difference in the physical properties of the compounds, original differences being compensated by the lower volatility and lower loss of dinonyl phthalate. Numerous other properties favour the latter compound, although its slightly higher brittle point makes it less suitable for compounds to be exposed to very low temperatures.

The compatibility of dinonyl phthalate with the important synthetic resins is substantially the same as dioctyl phthalate. Colour stability, electrical properties, staining and marking, sunlight ageing, water absorption and oil resistance of dioctyl phthalate and dinonyl phthalate are very similar, bearing in mind that some 10-15 per cent. more of the latter is usually recommended than is common with dioctyl phthalate.

Permanent Flexibility

Several new additions have been made to the adipates and, in particular, di-iso-octyl adipate is worthy of special comment. This is a primary plasticizer for most resins and imparts permanent flexibility, low water extraction, good electrical properties, good heat stability, excellent stability to ultra-violet light, and easy processing. It is a very efficient plasticizer and produces plastic film with low plasticizer-to-resin content, of good clarity and very good handle and drape. With nitrocellulose, clear, elastic films with low plasticizer content can be obtained and films of polystyrene plasticized with di-iso-octyl adipate are pliable, non-tacky and practically free from blocking.

The high volatility of dioctyl adipate has proved a serious disadvantage, although this plasticizer possesses very desirable low-temperature properties. Dinonyl adipate is substantially less volatile than the dioctyl compound. Both the ageing properties and low-temperature properties of dinonyl adipate are good, and it is considered likely that this plasticizer will find general applications for compounds where service conditions cover a wide range of temperatures.

Acetyl trihexyl citrate is a newcomer to the citrates, and it is particularly suitable for plasticizing vinyl polymer and co-polymer films to be used for food packaging. This citrate has advantages over the well-known triethyl citrate, tributyl citrate, acetyl triethyl citrate and acetyl tributyl citrate, as it offers a lower volatility and greater compatibility.

Resistance to Embrittlement and Discoloration

In the pilot plant stage of development are the esters of aconitic acid. This tribasic acid contains a double bond and may be formed by the removal of the elements of water from the citric-acid molecule. Although this double bond is not especially reactive and the esters do not tend to polymerize themselves, they may serve as stabilizers for polyvinylidene chloride resins. The butyl and higher esters are suggested for use in vinyls, while the lower esters are solvent plasticizers for cellulose acetate. In the latter case, exceptional resistance towards embrittlement and discoloration due to light is provided in films incorporating aconitates.

The family of glycol esters are assuming increasing importance and some of them give results comparable with D.O.P. at a reduced cost. Polyethylene glycol di-2-ethylhexoate is particularly interesting as its excellent low-temperature flexibility, added to its non-volatility and efficiency, makes it of interest to those working with surface coatings, moulded, extruded and calendered plastics compositions, also synthetic rubbers. Triglycol dihexoate is also recognized as outstanding for low-temperature flexibility. It is less volatile than dibutyl phthalate and possesses excellent resistance to discoloration under the influence of ultra-violet light. It is more permanently retained in films of vinyl butyral resin than in films of vinyl chloride-acetate resins. Triglycol dihexoate is a superior plasticizer for the vinyl butyral resin used in the plastic interlayer of high-strength safety glass.

Resistance to Petroleum Hydrocarbons

Some of the new glycolates are of interest to manufacturers interested in petrol-resisting sheeting, tubes, etc. Resistance to petroleum hydrocarbons, along with non-toxicity, wide compatibility, chemical stability makes the glycolates excellent for use with vinyls, cellulose acetate, nitrocellulose and synthetic rubbers of the Buna-N type, in the production of tough, flexible films, sheeting and tubing.

Plasticizers of the oil group are now being increasingly used where flexibility and drape are very important properties, and of the new compounds those based on azelaic acid can be recommended. The 2-ethyl hexyl ester of azelaic acid has a number of outstanding properties which make it a good primary plasticizer, particularly for the vinyls. Among these properties are low volatility and high water resistance. It imparts excellent low-temperature flexibility to films which are clear, free from haze, and possesses excellent tear strength. Dioctyl azelate is also recommended for clear films which are required to possess outstanding low-temperature performance.

Non-migration Qualities

Non-migration of plasticizers is of importance where plasticized materials come in contact with painted, lacquered or varnished surfaces, as migration of plasticizer may cause ugly stains. Several new plasticizers have been developed to overcome this danger of "sweating-out" or "blooming." One type is based on fatty, phthalic acid esters. This has the advantage of solving the problem of cold-streaking on the calender, which is common with such plasticizers as dioctyl phthalate. A typical compound of the fatty phthalic acid ester type has a freezing point of −47 degrees C. (stiff gel); pour point, −15 degrees C.; flash point, 224 degrees C.; fire point, 243 degrees C.; mid-boiling point at 4 mm. 228 degrees C.; vapour pressure at 150 degrees C. 0.6 mm. mercury, and at 200 degrees C. 1.2 mm. mercury; solubility in water is 0.01 per cent. maximum, and it has complete solubility in petrol and mineral oil.

Plasticizers based on fatty phthalic acid esters are very suitable for resin-plasticizer paste compounds. They are primary plasticizers for most resins and impart permanent flexibility, good electrical properties, heat stability, easy processing, ultra-violet light stability, excellent drape and handle, and high resilience and gloss.

The polymeric plasticizers, such as co-polymers of butadiene and acrylonitrile, e.g., "Hycar" of British Geon, Ltd., and "Perbunan" of Anglo-American Oil Co., Ltd., are specially useful where low volatility and low extraction rates are prime requirements. According to American experience, in the range of 18 to 40 per cent. acrylonitrile in the polymer, it is generally found that high nitrile content favours compatibility with vinyl resins and low nitrile content

(*Continued on page 32.*)

Successful Designing for Plastics Moulding

By W. M. HALLIDAY

This is the first of a complete series of articles dealing with all design aspects arising in the development of suitable component forms, economical mould design and construction, and the determination of the appropriate moulding technique.

FOR the successful and economical manufacture of satisfactory moulded articles, which have to meet specific requirements laid down by the user, as well as to conform to the needs and limitations of the moulding process, three chief phases of design will arise. The determination and solution of the various problems connected thereto, generally, are part of the duty of the plastics technician, or mould designer, or of both, in close consultation together, and usually, with the prospective user.

A Threefold Design Problem

These three essential forms of design consideration are: First, those connected with the evolution of the most suitable shape, features, size, material, and general characteristics of the component which has to be moulded.

Secondly, comes the phase comprising the large and vital set of factors associated with the design of the mould for producing such a component. Allied very closely to this second design problem is the one of mould manufacture, and the satisfactory determination of the most convenient, inexpensive, and reliable method of producing the mould with the equipment at the disposal of the mould maker.

Thirdly, there is the whole question or, rather, the set of problems surrounding the determination of the most appropriate moulding technique and procedure to be adopted in the manufacture of the moulded article.

With this question, too, is bound up that of the selection of moulding materials from which the component is to be made, the choice of moulding plant, and general operating procedure and instructions.

Generally it will be found that the solution of these design problems is performed by the mould designer; at any rate he will largely influence, and rightly so, the design characteristics incorporated in the projected component. He will determine all the design features of the mould and the operating moulding technique to be employed.

The component design must be worked out by one who not only possesses an intimate knowledge of the working of the various plastics compounds which are now employed, but also a full understanding of the highly specialized business of mould design and construction; and having, too, some practical acquaintance with the needs, requirements and limiting factors connected with any one of the numerous procedures which may be adopted.

Many potential users of plastics mouldings are often entirely unfamiliar with these vital technical matters, and as a result they are incapacitated to that extent from laying down binding restrictions governing the shape, size, and general design form which may be incorporated in the final moulded article.

Practically every engineering designer will be called upon at some time or another to fashion and design plastics moulded components, either as entirely new and unique articles, or as replacements for some component produced by the more orthodox methods of manufacture.

To derive the fullest advantages inherent in the plastics moulding process it is vitally necessary that the component form be developed by one who understands those needs most fully, that is, in fact, the specialist moulder. To accomplish this, in the general run of cases, implies close co-operation between the user and the moulder. The first requirement for establishing such co-operation is, of course, that the user shall be perfectly candid in passing along explanations of the particular service conditions which the component will have to meet, and exactly what functions it has to fulfil.

In a preceding short series of articles dealing specifically with this subject of co-operation between the user and moulder, published in this journal, June, July and August, 1943, the present author outlined a large number of important factors associated with the manner in which a component design is usually achieved, and a plea was there made for the creation of frank and full co-operation between potential user and the moulder specialist. Interested readers are referred back to this series of articles. It illustrated the many useful ways in which such co-operation can be developed, and canalized to secure more satisfaction to all concerned in the production of successful plastics mouldings.

Shortcomings in respect of the design of a plastics moulded component may arise not only as a result of lack of knowledge of the limitations of the process, but also because of the failures to appreciate toolmaking restrictions in regard to mould manufacture and usage. Alternatively, certain features may be stipulated as important by the user, but which cannot be obtained by the moulder because no single type of moulding material possesses such qualities.

In those cases where it is not absolutely essential for the user to stipulate design forms of one kind or another, it is far better to allow the greatest freedom to the mould technician or designer, so that he may be enabled to adapt, to modify, or even drastically to transform the user's original suggestions respecting design forms. In this way, it is far more easily possible to obtain a correctly designed moulding, capable of meeting more exactly the user's requirements. At the same time, it will probably prove less expensive, because numerous objectionable features will be eliminated at the outset. Certainly the whole development of the component design will then be associated with far less worry, problems and snags.

With many plastics moulded articles of intricate configuration much valuable time may be wasted and additional expense incurred by the mould maker attempting to achieve what are in effect really difficult or even downright unsuitable forms. This kind of thing leads obviously to an increase in the final costs for the moulded parts, as well as materially inflating the initial mould charges.

Therefore, the closer the co-operation between user and designer, the greater likelihood there will be of finally obtaining satisfactory mouldings, at lower prices, and with far less worry.

Factors Determining Component Designs

Component design is determined in the last resort by a number of highly important factors, which will now be very briefly enumerated, and more fully explained and discussed in succeeding sections of this series. Four of these factors only are mentioned at this point:—

(1) DESIGNING THE COMPONENT TO MEET ITS SERVICE CONDITIONS

The prospective user of a potential projected plastics moulded product will obviously have certain ideas in view. Thus he may wish to obtain a component to replace an article hitherto employed but which has been made in metal, wood, or some other non-plastic material. He may desire a moulded component having great mechanical strength, the ability to withstand shock or wear, high dielectric qualities, or one having improved surface appearance, or economies in costs, and so forth.

In short, it will require the provision of every physical feature which will render the finished moulded article capable of more satisfactorily meeting

the particular service conditions to which it will be subjected.

Designing the component form to meet such requirements demands considerable skill, knowledge, and foresight on the part of the plastics moulder. Very many problems will have to be solved in deciding this question to the best advantage.

(2) DESIGNING THE COMPONENT FOR SUCCESSFUL MANUFACTURE

The style of component decided upon; the type of plastics mould developed; the material to be used; the features required; and the quantities of mouldings to be produced, are the factors largely determining the method of manufacture which can be used. This problem cannot usually be settled in isolation from the foregoing essential factors.

(3) DESIGNING THE COMPONENT FOR MATERIAL

The shape, size and features required in the component will decide the kind of material which can be employed in its manufacture. To a lesser extent the process of manufacture will also condition the kind of material to be used. In determining this matter the designer will usually have to make a very careful check up of the mechanical and physical properties desired in the finished moulded article, and then select a material which will most closely fulfil such requirements.

It deserves to be mentioned here that generally it will be necessary to determine the type of material at the very outset of the development of the component design. Once the material has been chosen with reliability, the designer may then proceed to work out the detailed component design, its shape, sizes, forms, etc., making due allowance for shrinkage, and other peculiarities known to be possessed by the particular material selected.

Colour, texture, surface finish, etc., may also condition the selection of material, and incidentally when deciding this question the mould technician should be furnished with exact details of the user's wishes or needs.

(4) DESIGNING THE COMPONENT FOR THE MOULD DESIGN

Very often the component design has to be modified or adapted when the question of mould design is under consideration. Innumerable apparently minor points may be incorporated in the component design, the reproduction of which will raise difficulties during mould manufacture, or later in the operation of the mould. It is far better that such points be settled whilst the mould design is at the drawing-board stage. Once again we revert to the important question of co-operation between user and mould designer!

General Requirements of Component Design

The mould designer has not only to fashion a tool which will reproduce the shape of component required, but has also to design it so that it can be operated economically, and will give uniformly accurate and reliable service for a lengthy period.

Within these broad limits of application, a properly designed plastics moulded component must also be capable of satisfying the following important requirements, if economical and successful manufacture is to be attained:—

(a) The component design must be of a character rendering use of the most simple and economical form of die construction.

(b) The design must also be that which permits the most durable and reliable form of die design.

(c) The component design should be of a character which ensures the most economical utilization of the plastic moulding material to be employed.

(d) The component design must also be such as to lead to the most economical form of moulding procedure.

(e) The design form should also entail the minimum amount of trimming, cleaning, or subsequent machining of the part, after moulding.

(f) The component design should be one calling for the least amount of mould maintenance during production.

In the ensuing sections all these points will be considered much more fully and the preferred design principles ascertained as a result of practical experience in the working of plastics will be described and illustrated by actual examples.

Basic Requirements of the Mould

Turning now to the matter of mould designing, a great number of very important considerations again arise for settlement by the mould designer. He will first have to decide the style or type of mould to employ. Now he will have to determine whether to use a single or a multi-impression tool. The question of the manufacture of the mould will then arise, and in particular, in what precise manner the necessary cavity formations are to be provided.

Whilst each mould design is usually something of a special and unique nature, due to particular characteristics of the moulded component, certain common and specific forms and elements will have to be employed in the mould. The set of elements thus used will vary, depending upon whether the mould is intended for use by the compression, injection, transfer or extrusion process of moulding. In later sections of this series numerous illustrations will be furnished of these main mould elements, together with their application, and reasons underlying their use, as well as the advantages to be derived.

To a large extent also the question of mould design will be conditioned by the type of mould-making plant available and the kind of moulding press or injection machine upon which the finished tool will be used.

The basic requirements of any satisfactory moulding tool are briefly as follows:

(1) It should ensure the accurate, correct and uniform reproduction of the component form.

(2) It should be as simple as practicable.

(3) The method of operating the mould should likewise be of the simplest character to allow for economical handling and production of the parts.

(4) It should permit the most economical use of moulding materials.

(5) It should be capable of withstanding prolonged production service without developing errors, faults or failures likely to affect adversely either the quality, accuracy, or form of the component, or to incur heavy maintenance costs in retaining the mould in production service.

(6) The mould should provide for forming the component as completely as possible, to eliminate secondary machining, trimming or deflashing operations.

(7) The mould must be constructed from suitable materials which will not stain, dye or become roughened due to continued exposure to the moulding components.

Moulding Process Requirements

With the moulding process to be selected, another set of problems will arise for solution by the plastics moulding technician. The nature and extent of this set of problems is very briefly mentioned in this introductory article.

In the first instance, the designer will have to determine whether the component has to be produced in a thermosetting or a thermoplastic material. Decisions on this point will settle whether the part can be compression or injection moulded.

Next he must decide what type, size and kind of moulding press or injection machine has to be employed. If the part has to be produced from a multi-impression tool, and consequently, from a correspondingly large mould involving a large projected surface area over the respective mould cavities, it will be necessary to employ a large and powerful moulding press which is capable of exerting the requisite pressure on the mould.

If, on the other hand, the mould can be a single-impression tool and the projected surface area of the mould cavity relatively small, a much lighter moulding press may be employed.

He has then to decide the exact form of moulding procedure to be adopted. This will embrace such points as the length of cure, the amount of pressure and squeeze pressure to be used, the length of the complete moulding cycle, in what manner the cavity formations are to be charged with powder, how the powder charge has to be measured, what type of gauges to use, and so forth.

In short, he will have to work out, largely as a result of cut-and-try methods with the actual mould, a whole procedure

scheme for guidance of the mould operator.

If the component has to be produced as an injection-moulded part, here again the type of mould will determine the size of machine which can be used. The capacity of all the mould cavities must not exceed more than about 70 per cent. of the whole delivery of the injection machine per shot.

Operating sequences, timing and operator instructions will also have to be determined. In addition, a scheme of inspection of the finished mouldings, however they be produced, will become necessary in order to ensure that the quality, accuracy and uniformity of the finished parts is maintained and customers' requirements in this respect are attained.

These, then, are some of the problems which will be considered in the sections of the series which will follow.

As already intimated, it is proposed to devote a number of sections immediately following the present one to the consideration of the various points affecting and determining component design. Having explained the basic requirements and the principles to be followed, successive sections will deal with the similar closely connected problems of mould design. Copious illustrations will be given of the various more or less standard types of mould constructions to note their capacity, limitations and advantages, and particularly to show the inter-action between component design and mould design.

The final sections will deal with the development of moulding procedures for adoption with the various types of moulds. In short, the whole field of designing for plastic moulding will be discussed and the many problems considered in detail, in conjunction with illustrated practical examples of components and moulds which have been found successful and economical in production use.

(To be continued.)

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Printing on Cellulose Acetate

Sir,—We were particularly interested in the article on printing and decorative finishing of cellulose acetate, by Vivian Stannett, appearing in the May issue of "Plastics."

We are anxious to acquire a fast drying ink for printing on a non-porous, non-resilient type of material, and should be pleased to receive as much information on the subject as possible, especially as regards the correct method of feeding the ink to the stamp should this differ from normal printing practice.

BRITISH UNITED SHOE MACHINERY CO., LTD.
Belgrave Road,
Leicester.

[EDITOR'S NOTE: The production of inks of this type is not carried out by the plastics industry itself; it is done by the inks section of the paint and varnish industry. You should communicate with one of the following firms: Mander Bros., Wolverhampton; Cellon, Ltd., Richmond Road, Kingston; Coates Bros. and Co., Ltd., Easton Street, London, W.C.1.]

Injection Moulding

Sir,—Can you advise me of the names of some moulders who are equipped with 12 to 16-oz. injection moulding machines and who specialize in moulding polymethyl methacrylate?

J. C. SEWARD.
The Pound House,
Chinnor, Oxford.

Knitting Pins

Sir,—We have an inquiry from an Australian customer for plastic material for making into knitting pins and they apparently have in mind imitation tortoiseshell. If you can suggest any suitable manufacturer it would be appreciated.

W. A. SPARROW AND CO., LTD.
65, London Wall, E.C.2.

[EDITOR'S NOTE: The usual material for making knitting pins, and imitation tortoiseshell, is casein. This can be obtained from Erinoid, Ltd., Lightpill Mills, Stroud, Glos., and BX Plastics, Ltd., Larkswood Works, Higham Station Avenue, Chingford, E.4; The Aberdeen Combeworks Co., Ltd., 40, Hutcheon Street, Aberdeen, Scotland, and Charles Horner, Ltd., Mile Cross Works, Halifax. Cellulose acetate extruded rod can also be employed for the purpose of making knitting pins; BX Plastics, Ltd., also make this material.]

Tool Handles

Sir,—We have had an inquiry from a customer in Holland for 100,000 yellow transparent handles for screwdrivers. It occurred to us that one of your many subscribers might be able to help us in our endeavours to find a supplier. The sizes of the handles required are from 4.5 cm. to 10.2 cm. by 1.2 cm. to 2.7 cm. respectively; they must be stamped "10,000 volts."

NICOLENE, LTD.
87, Regent Street, London, W.1.

P.V.C. Belting

Sir,—I would be obliged if you could inform me of the names of manufacturers of p.v.c. belting as sample enclosed; alternatively, of any wholesale house stocking this material.

K. POVALL.
22, Hillway,
Littleover, Derby.

[EDITOR'S NOTE: The sample is a ribbed p.v.c. strip $\frac{1}{2}$ in. wide and about 1/32 in. thick, of light blue colour.]

Syringes

Sir,—Can you tell me if there are any firms in this country producing syringes (approx. 9 in. long) made of plastic material?

NATIONAL UNION OF MANUFACTURERS.
6 Holborn Viaduct, E.C.1.

P.V.C. Sheet

Sir,—We would be obliged if you would put us in touch with manufacturers of flexible plastic material for the making of stencils.

RELIABLE SUPPLY CO.
48, Middle Abbey Street,
Dublin.

Tops for Café Tables

Sir,—We shall be obliged if you can let us have the names and addresses of firms manufacturing plastic circular tops for café tables.

W. T. FIELDING AND SONS, LTD.
165-169, Burley Road,
Leeds, 3.

P.V.C. Sheet

Sir,—We are looking for a reliable manufacturer of p.v.c. in sheets of .020 in. thickness, high-gloss finish, polished on one side and matt on the other side; also sheets .004, .005, .006 and .008 in. thick, either plain or printed, transparent or frosted.

We should also like to obtain the agency for a reliable manufacturer who is willing to export to Brazil but not yet represented here.

SCHLOSSINGER AND CIA., LTDA.
Caixa Postal 917,
Sao Paulo, Brazil.

There's Nothing Like Leather

Sir,—We have read with great interest the article "There's Nothing Like Leather," in "Plastics" for July, 1949. We have always appreciated your forward-looking views and it is gratifying to find them so ably expressed in a prominent journal concerned with this vitally important industry.

S. CLARKE AND CO., LTD.
Clerkenwell, E.C.1.

Cold-setting Resin

In the Editor's Note to this inquiry published in "Plastics," June, 1949 (page 322), we omitted to mention that cold-setting resins are also supplied by Bakelite, Ltd.

once again . . .

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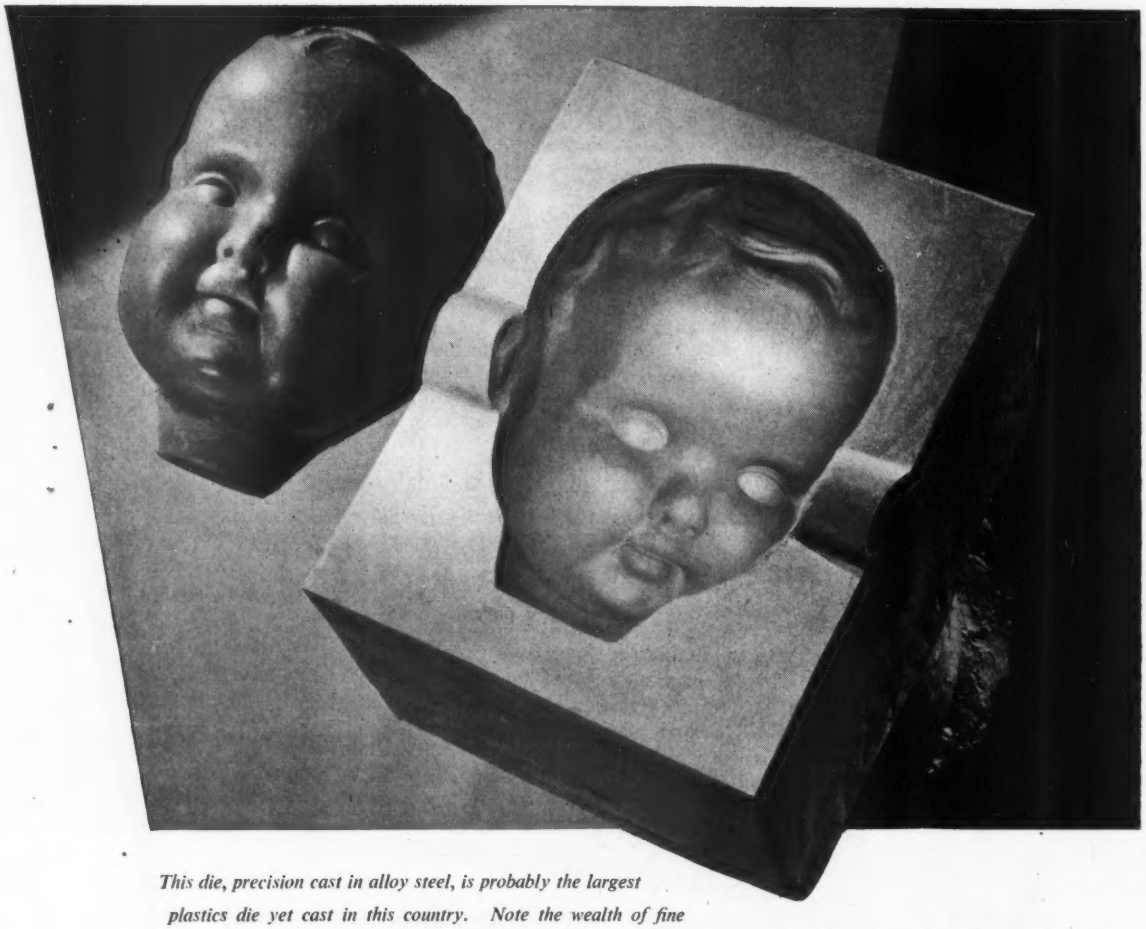
The new ULTRA Twin in its three piece moulded plastic cabinet. Body and back are compression moulded in phenol formaldehyde material. The panel is injection moulded in methyl methacrylate material, one panel and three control knobs being produced in one shot.

BM126



This die, precision cast in alloy steel, is probably the largest plastics die yet cast in this country. Note the wealth of fine detail in the wax impression which was taken direct from the die before any finishing operations had been carried out.

Now — PRECISION CASTING

For the first time in this country precision cast moulds and mould parts are available to the plastics moulding industry. This new process offers many advantages. An almost unlimited choice of alloy steels. Accurate and economical reproduction of identical parts, showing a great saving of time. Finishing processes reduced to a minimum and the ultimate finish comparable in every respect with that obtained by more conventional methods. If it's an urgent job, stipulate this new B.I.P. Tools process, combining speed (without haste) and . . .

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PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2/- each.

B.P. 618,195. Appl. 1.11.46. Acc. 17.2.49.
Preparation of Solutions or Dispersions of linear super Polyamide and the Treatment of Fibrous Materials therewith. R. P. Foulds and W. H. Roscoe. To: Tootal Broadhurst Lee Co., Ltd.

B.P. 618,250. Appl. 1.4.46. Acc. 18.2.49.
Soothing Teats or Babies' Comforters. D. Atkin.

B.P. 618,251. Appl. 4.4.46. Acc. 18.2.49.
Cation Exchange Resins. T. R. E. Kresman. To: Permutit Co., Ltd.

B.P. 618,295. Appl. 14.10.46. Conv. (U.S.A.) 5.11.45. Acc. 18.2.49.
Process for increasing the rate of Polymerization of Dialyl Phthalate. E. C. Shokal and C. W. Schroeder. To: N. V. de Bataafsche Petroleum Manatschappij.

B.P. 618,338. Appl. 19.10.46. Acc. 21.2.49.
Dolls, Animals and like Figures and the manufacture of same. H. Senior and G. Tomlinson. To: Cascelloid, Ltd.

B.P. 618,345. Appl. 23.10.46. Acc. 21.2.49.
Method of securing Adhesion between Polyethylene and other materials C. E. Richards, R. L. Bull and H. F. Wilson.
Polythene may be secured to a base material of different nature through the intermediary of a film or layer comprising polyisobutylene which is bonded to the base material.

B.P. 618,440. Appl. 4.5.46. Acc. 22.2.49.
Manufacture of Sulphur-containing Organic Polymers. M. Goldstaub. To: Dunlop Rubber Co., Ltd.
A process for the protection of acetal thioplasts having terminal hydroxyl groups which comprises degrading an acetal thioplast of higher molecular weight by heating a mixture thereof with an acid reagent and water.

B.P. 618,449. Appl. 29.5.46. Acc. 22.2.49.
Manufacture of Organic Sulphur-containing Polymers and novel cold-setting products obtained therefrom. M. Goldstaub. To: Dunlop Rubber Co., Ltd.
A process for the production of a novel liquid product which comprises esterifying a liquid disulphide acetal thioplast having terminal hydroxyl groups by heating an anhydrous mixture thereof with a dicarboxylic acid or an acid chloride or anhydride of such an acid and cooling the mixture after thickening occurs but before gelation sets in.

B.P. 618,451. Appl. 5.6.46. Conv. (U.S.A.) 11.6.45. Acc. 22.2.49.
Methyl Silicone Elastomers containing Si-bounded Vinyl Radicals. To: British Thomson-Houston Co., Ltd.

B.P. 618,452. Appl. 11.6.46. Conv. (U.S.A.) 11.6.45. Acc. 22.2.49.
Preparation of Methyl Silicone Gums and Elastomers. To: British Thomson-Houston Co., Ltd.

B.P. 618,453. Appl. 11.6.46. Conv. (U.S.A.) 11.6.45. Acc. 22.2.49.
Methyl Silicone Gums and Elastomers. To: British Thomson-Houston Co., Ltd.

B.P. 618,459. Appl. 20.6.46. Acc. 22.2.49.
Organo Siloxanes and method of making the same. To: Dow Chemical Co.

B.P. 618,464. Appl. 8.7.46. Acc. 22.2.49.
Diathermic Seaming Apparatus. O. J. Russel. To: P.R.T. Laboratories, Ltd.
High-frequency seam-welding machine in which at least a part and preferably substantially all the necessary driving force for feeding the sheet material between the counter electrodes is arranged to be transmitted by means of presses which connect the material to one or both sides of the region which is heated for affecting the weld seam.

B.P. 618,477. Appl. 2.9.46. Acc. 22.2.49.
Production of Optical Elements. C. H. Crooks and W. A. Greenwood. To: Imperial Chemical Industries, Ltd.
Production of optical elements by making a rigid preform and applying to the surfaces of the preform a coating of an adhesive composition of one or more polymerizable compounds in liquid form, subjecting the coating to polymerizing conditions and thereafter trapping between the solid-coated surface and a mould surface a syrup which is composed of organic compounds and polymerizing this film by heat and light.

B.P. 618,478. Appl. 6.9.46. Conv. (U.S.A.) 30.10.45. Acc. 22.2.49.
Stabilization of Nuclear Chlorostyrenes. E. R. Erickson. To: Mathieson Alkali Works.

B.P. 618,480. Appl. 2.9.46. Conv. (U.S.A.) 2.6.45. Acc. 22.2.49.
Silicone Polymers. To: Westinghouse Electric International Co.

B.P. 618,518. Appl. 2.2.46. Conv. (Italy) 18.9.42. Acc. 22.2.49.
Apparatus for Mixing and Extruding Plastic Materials. To: S.P.A. Lavorazione Materie Plastiche.
An apparatus for mixing and extruding plastic materials and more particularly thermoplastic materials, comprising a central screw meshing with a plurality of screws arranged in a circle around said central screw and adapted to rotate in the same direction as said central screw.

B.P. 618,536. Appl. 30.7.46. Acc. 23.2.49.
Extrusion Apparatus. D. C. Nicholas. To: B.X. Plastics, Ltd.
Extrusion apparatus comprising rotary feed screw having a core or mandrel attached extending up to or beyond the extrusion orifice of the die, in which a helical thread is provided in the external surface of the die or the external surface of the core or mandrel whilst the other surfaces are relatively smooth.

B.P. 618,608. Appl. 11.6.46. Conv. (U.S.A.) 11.6.45. Acc. 24.2.49.
Preparation of Alkenyl Substituted Chlorosilanes. To: British Thomson-Houston Co., Ltd.

B.P. 618,614. Appl. 15.8.46. Conv. (U.S.A.) 14.5.46. Acc. 24.2.49.
Processes for applying Pigments to the surfaces of Thermoplastic Materials. D. O. Ford.
A process for fixing a pigment to the surface of a thermoplastic material which includes the steps of heating the clean surface of the material and applying to the heated surface a solvent for the material. The combined action of the heat and solvent produces a softening of the surface, applying a pigment to the softened surface and then allowing the surface to harden, whereby the pigment is left in the surface region of the material amalgamated therewith.

B.P. 618,674. Appl. 24.8.45. Conv. (U.S.A.) 23.3.42. Acc. 25.2.49.
Catalytic Polymerization of Hydrocarbons. To: Phillips Petroleum Co.
Refers to the use of oxides of iron, nickel or cobalt catalysts. These are activated by previous heat treatment in the presence of oxygen.

B.P. 618,691. Appl. 2.10.46. Acc. 25.2.49.
Acrylate Ester Polymers. To: Standard Oil Development Co.
Refers to the use of acrylates as copolymers and their use as pour-point depressors for waxy mineral lubricating oil.

B.P. 618,787. Appl. 16.7.46; 2.9.46. Acc. 28.2.49.
Production of Optical elements. A. White. To: Imperial Chemical Industries, Ltd.

B.P. 618,829. Appl. 13.11.46. Conv. (France) 27.12.45. Acc. 28.2.49.
Process for Dyeing Polyvinyl Derivatives. To: Société Rhodiaceta.
A process for dyeing threads, filaments, fibres, artificial horse-hair fabrics and all materials and articles having a basis of polyvinyl derivatives characterized by the fact that the dyeing is carried out in the presence of pine oil or one or more of its compounds.

B.P. 618,830. Appl. 13.11.46. Acc. 28.2.49.
Machines Joining Sheet Materials by the heating effect of electric stress alternating at high frequency. P. Jones. To: British Insulated Callenders Cables, Ltd.
High-frequency seam-welding machine (roller type) in which the drive to feed the material through the machine is adopted to be automatically adjusted in the speed by means responsive to variation in the gap between the rollers due to alteration in softness of the material so as to maintain satisfactory joining of the layers.

B.P. 618,839. Appl. 15.11.46. Conv. (U.S.A.) 15.11.45. Acc. 28.2.49.
Polymers of Ethylene. To: E. I. du Pont de Nemours and Co.
A composition comprising a major proportion of polythene and a minor proportion—0.05 per cent. to 5 per cent. by weight of propyl gallate as a stabilizer.

B.P. 618,902. Appl. 9.10.46. Acc. 1.3.49.
Treatment of Polyvinyl Chloride. J. Downing. To: British Celanese, Ltd.
Manufacture of vulcanizable polymers by reacting an acetone insoluble polyvinyl chloride with a dehydrochlorinating agent so as to remove at least 3 per cent. and not more than 10 per cent. of the compound hydrogen chloride from the polyvinyl chloride.

B.P. 619,211. Appl. 27.11.46. Acc. 4.3.49.
High Frequency Heating Processes. J. H. Ludlow. To: Metropolitan Vickers Electrical Co., Ltd.
The novelty of the invention is the pro-

vision of audible or visible signals indicating the termination of the curing process.

B.P. 619,231. Appl. 11.6.46. Conv. (U.S.A.) 15.6.45. Acc. 7.3.49.
Catalytic Polymerization of Olefins. To: Phillips Petroleum Co.

Polymerization of olefin hydrocarbons using nickel oxide supported on silica gel and activated by heat treatment as catalyst.

B.P. 619,244. Appl. 27.11.46. Acc. 7.3.49.
High Frequency Heating Apparatus. J. H. Ludlow. To: Metropolitan Electrical Co., Ltd.

The main object of this invention is to provide equipment which combines screening of the high-frequency circuits with compactness.

B.P. 619,245. Appl. 27.11.46. Acc. 7.3.49.
High Frequency Electrical Power Supply Systems. J. H. Ludlow. To: Metropolitan Vickers Electrical Co., Ltd.

B.P. 619,246. Appl. 27.11.46. Acc. 7.3.49.
High Frequency Electrical Power Supply Systems. J. H. Ludlow. To: Metropolitan Vickers Electrical Co., Ltd.

B.P. 619,275. Appl. 29.11.46. Acc. 7.3.49.
Manufacture of Polymeric Urea. G. D. Buckley and N. H. Ray. To: I.C.I., Ltd.

A process for the manufacture of polycondensation products which comprise subjecting a polyamine and carbon dioxide to elevated temperatures, preferably between 100 degrees and 350 degrees C., and a pressure exceeding 100 atmospheres.

B.P. 619,295. Appl. 30.11.46. Conv. (France) 14.5.40, 21.4.31. Acc. 7.3.49.
Manufacture of Injection Moulded Reinforced Articles made of plastic materials. E. A. Chapuis.

B.P. 619,356. Appl. 4.12.46. Acc. 8.3.49.
Anion Exchange Resins. J. R. Myles and W. J. Levy. To: I.C.I., Ltd.

Manufacture of an anion exchange or acid absorbing resin by subjecting a chlorinated paraffin wax and an alkylene polyamine to a temperature between 110 degrees and 160 degrees C. for at least six hours.

B.P. 619,384. Appl. 5.12.46. Acc. 8.3.49.
Manufacture of Lenses from transparent polymerizable Organic Plastics. J. Johnson. To: Combined Optical Industries, Ltd.

Ophthalmic lenses made from methyl methacrylate or allyl methacrylate.

B.P. 619,394. Appl. 6.12.46. Conv. (U.S.A.) 6.12.45. Acc. 8.3.49.
Production of vinyl fluoride. To: I.C.I., Ltd.

B.P. 619,398. Appl. 6.12.46. Conv. (Australia) 11.12.45. Acc. 9.3.49.
Dielectric Heating and Electrodes therefor. To: Standard Telephones and Cables, Ltd.

Refers to self-heating electrodes.

B.P. 619,503. Appl. 24.10.45. Conv. (France) 12.10.43. Acc. 10.3.49.
Wrapping of articles. C. Nicolle.

A multi-cellular wrapper formed by two sheets of cellulose acetate or other like plastic material between which the goods to be wrapped are enclosed, characterized by the formation in at least one of the said sheets of reinforcement groove like or other recessed portions which are spaced from the facing portion of the other sheet—the two sheets being secured together at the portions which bind the recessed portions.

B.P. 619,513. Appl. 4.4.46. Conv. (Netherlands) 24.10.42. Acc. 10.3.49.
Manufacture of Aqueous Dispersions of Polymers of substances capable of Polymerization. N. V. de Bataafsche Petroleum Maatchappij.

B.P. 619,564. Appl. 7.12.46. Acc. 10.3.49.
Manufacture of Cellulose Acetate Filaments, films or the like. T. F. Barrington.

B.P. 619,576. Appl. 13.12.46. Acc. 12.12.47.
New Polyamides. E. Ellery and R. J. W. Reynolds and I.C.I.

B.P. 619,620. Appl. 16,12.46. Conv. (U.S.A.) 15.12.45. Acc. 11.3.49.
Polymerization of Chloroprene. To: E. I. du Pont de Nemours and Co.

B.P. 619,674. Appl. 25.7.45. Acc. 14.3.49.
Laminated Resin-bonded Fibrous Sheet Material. To: Owens Corning Fiberglas Corporation.

B.P. 619,905. Appl. 25·10.46. Conv. (U.S.A.) 29.3.45. Acc. 14.3.49.
Methods and apparatus for Shaping Sheet Thermoplastic Material centrifugally. To: Goodyear Aircraft Corporation.

B.P. 619,707. Appl. 16.12.46. Acc. 14.3.49.
New Polyamides of the Nylon type. E. K. Bolton and W. Kirk, Jnr. To: E. I. du Pont de Nemours and Co.

B.P. 619,758. Appl. 14.2.44. Conv. (U.S.A.) 15.2.43. Acc. 15.3.49.
Stabilization of Halogenated Ethylenes containing Fluorine. To: E. I. du Pont de Nemours and Co.

Stabilization of fluorethylenes against spontaneous polymerizations by incorporating between 0.001 per cent. and 5 per cent. of a compound containing an amino nitrogen group.

B.P. 619,870. Appl. 4.4.46. Conv. (Netherlands) 20.7.45. Acc. 16.3.49.
Manufacture of Aqueous Dispersions of Polymers of substances capable of Polymerization. N. V. de Bataafsche Petroleum Maatchapij.

B.P. 619,905. Appl. 25.10.46. Conv. (U.S.A.) 27.10.45. Acc. 16.3.49.
Curing of Polyethylenes. To: E. I. du Pont de Nemours and Co.

B.P. 620,061. Appl. 30.9.46. Conv. (Switzerland) 9.1.46, 21.5.46. Acc. 18.3.49.
Moulded Articles. T. Holzer.

Manufacture of moulded articles which comprise mixing sulphite cellulose waste lye with animal albuminoid substances in the presence of a finely divided carrier, moulding and pressing (hot) the product obtained.

B.P. 620,116. Appl. 23.1.39, 1.3.39. Acc. 21.3.49.
Manufacture of Nitrogen containing Linear Polymers. H. Dreyfus.

B.P. 620,214. Appl. 9.1.47. Conv. (U.S.A.) 1.4.46. Acc. 22.3.49.
Improvements in Bags. H. Volksdorf. To: T. M. Royal and Co.

B.P. 620,296. Appl. 14.2.44. Conv. (U.S.A.) 15.2.43. Acc. 23.3.49.
Stabilization of Tetrafluorethylene. To: E. I. du Pont de Nemours and Co.

Stabilization is achieved by treating the tetrafluorethylene to reduce its oxygen content to not more than 40 parts per million.

B.P. 620,314. Appl. 19.8.46. Conv. (U.S.A.) 10.9.45. Acc. 23.3.49.
Aniline Condensation Product and process of preparing same. To: B. F. Goodrich Co.

B.P. 620,333. Appl. 2.1.47. Conv. (U.S.A.) 9.11.44. Acc. 23.3.49.
Apparatus for extruding Organic Plastic Material. J. Bailey and H. A. Pratt. To: Plax Corporation.

B.P. 620,390. Appl. 20.6.45. Conv. (U.S.A.) 22.6.44. Acc. 24.3.49.
Producing a Coated Elastic Fabric and the product produced. To: Sylvania Industrial Corporation.

B.P. 620,412. Appl. 18.7.46. Acc. 24.3.49.
Urea Formaldehyde Resinous Materials. J. D. Morgan and J. F. Williams. To: British Resin Products, Ltd.

B.P. 620,522. Appl. 19.11.46. Acc. 25.3.49.
Moulds for use in the Manufacture of Artificial Eyes. W. H. Shakespeare.

B.P. 620,565. Appl. 27.12.44. Conv. (U.S.A.) 22.4.44. Acc. 28.3.49.
Preparing Phenol Formaldehyde Resin Composition, the improved Phenol Formaldehyde Resin Composition resulting therefrom, and objects coated therewith. To: Heresite Chemical Co.

THE SEARCH FOR NEW PLASTICIZERS

(*Continued from page 27*).

favours low-temperature flexibility. The use of these has enabled manufacturers to obtain transparency, a high degree of flexibility, toughness and complete freedom from taste and smell. There is no doubt that the extended use of such polymeric plasticizers will lower processing costs and, by reducing the risk of plasticizers migrating, will greatly extend the scope of new plastics formulations.

Polymeric esters made from polyfunctional acids and polyfunctional alcohols are also recommended for vinyl polymers. Plasticizers of this type, although resinous in character, have a low viscosity, which makes possible the preparation of free-flowing organosols. High efficiency, excellent low-temperature performance, negligible volatility and complete oil resistance make these new resinous plasticizers excellent for p.v.c. For very soft stocks, they can be combined with chemical plasticizers, such as tricresyl phosphate and dioctyl phthalates. The following data are typical of one of this new type of plasticizer: Colour (Gardner), 7; refractive index, 1.4637 (25 degrees C.); sp. gr., 20/20 – 1.083; viscosity (poises at 25 degrees C.), 4; cloud point, −8 degrees C.; viscosity point, below −20 degrees C.; flash point, 530 degrees F.; fire point, 595 degrees F.

Books Received

"Silicones and other Organic Silicon Compounds." By H. W. Post. New York: Reinhold Publishing Corporation. London: Chapman and Hall, 30s.

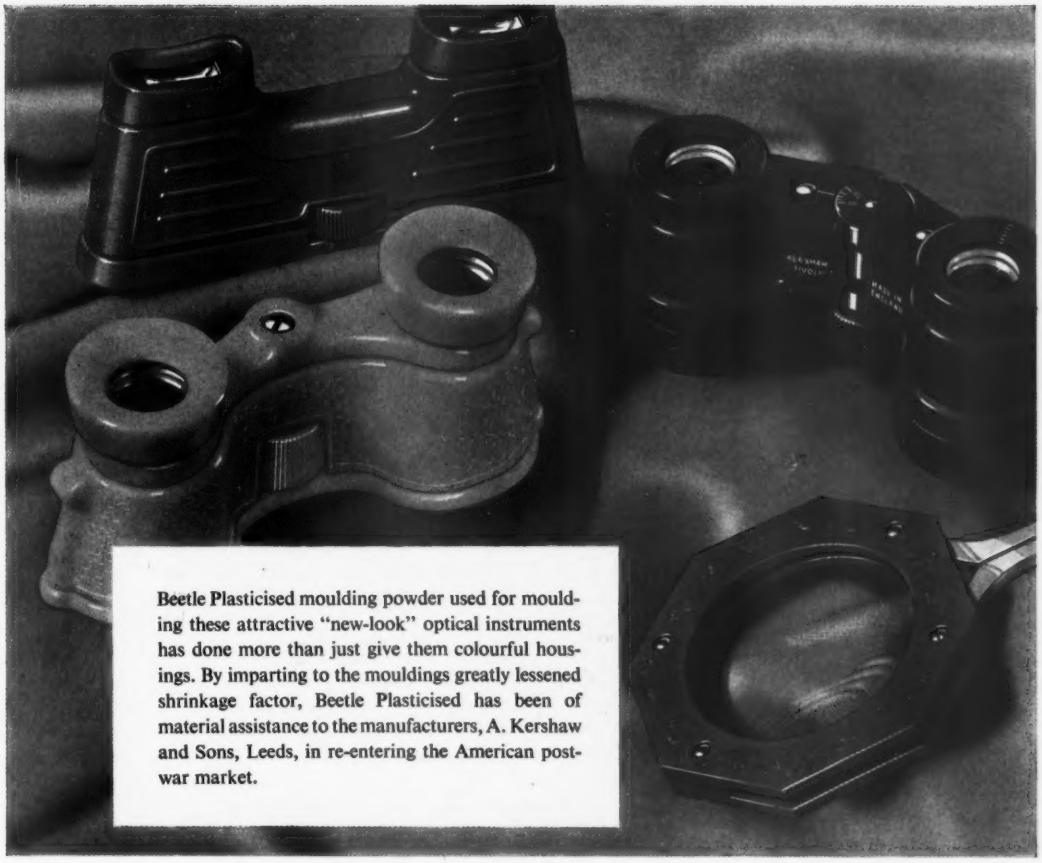
"Radio-Frequency Heating." By L. Hartshorn. London: George Allen and Unwin, 21s.

"Handbook of Plastics." By H. R. Simonds, A. J. Weith and M. B. Bigelow. 2nd Edition. New York: D. Van Nostrand Co. London: Macmillan, £7.

"Physics and Chemistry of Cellulose Fibres, with Particular Reference to Rayon." By P. H. Hermans. Amsterdam: Elsevier Publishing Co. London: Cleaver-Hume Press, 50s.

"Elastomers and Plastomers." By R. Houwink. Amsterdam: Elsevier Publishing Co. London: Cleaver-Hume Press, 50s.

"Organic Coatings in Theory and Practice." By A. V. Blom. Amsterdam: Elsevier Publishing Co. London: Cleaver-Hume Press, 32s.



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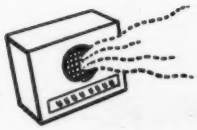

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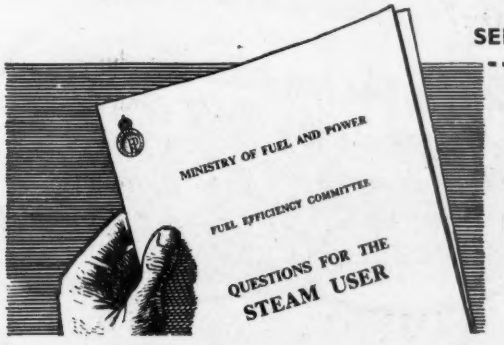

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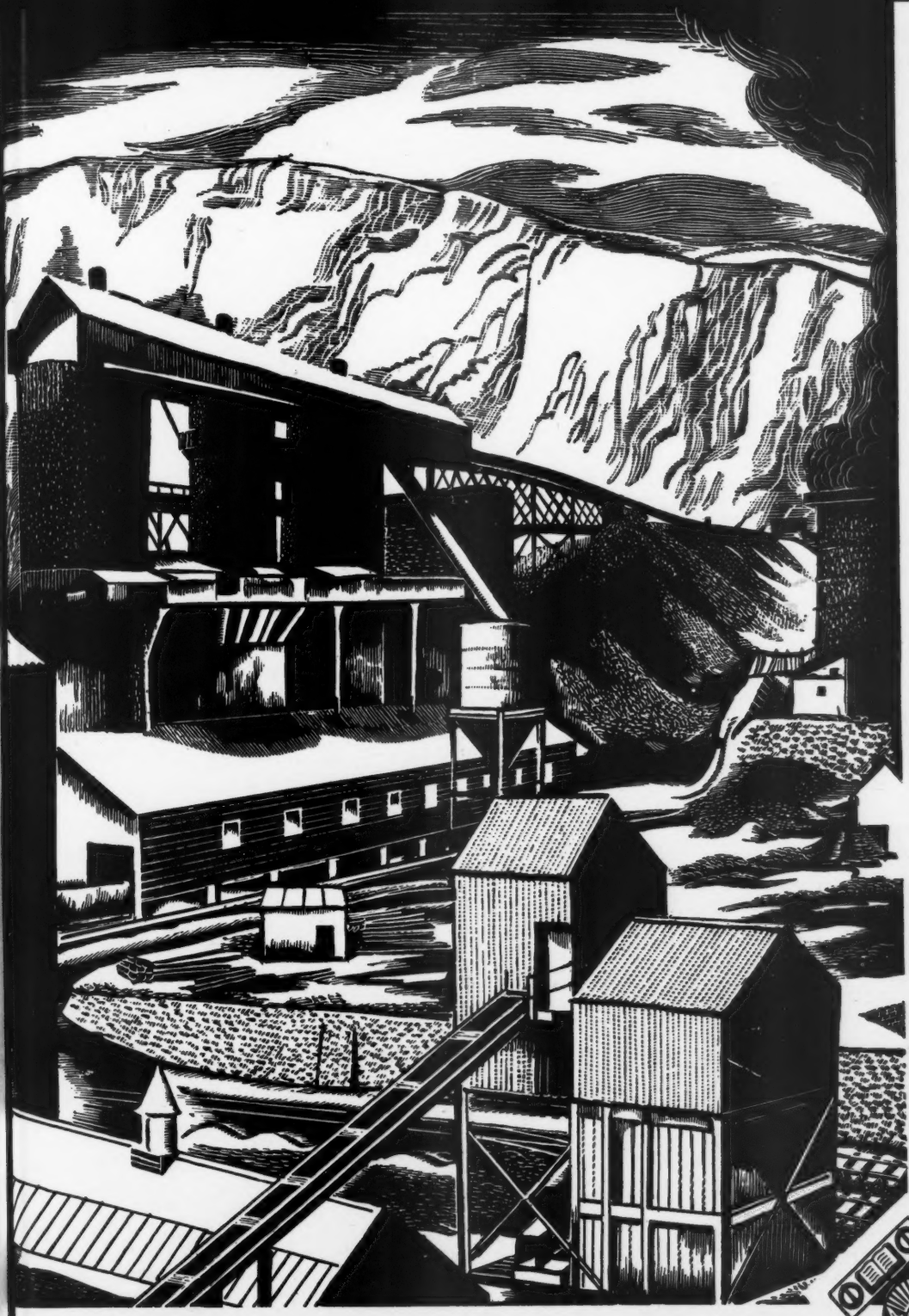

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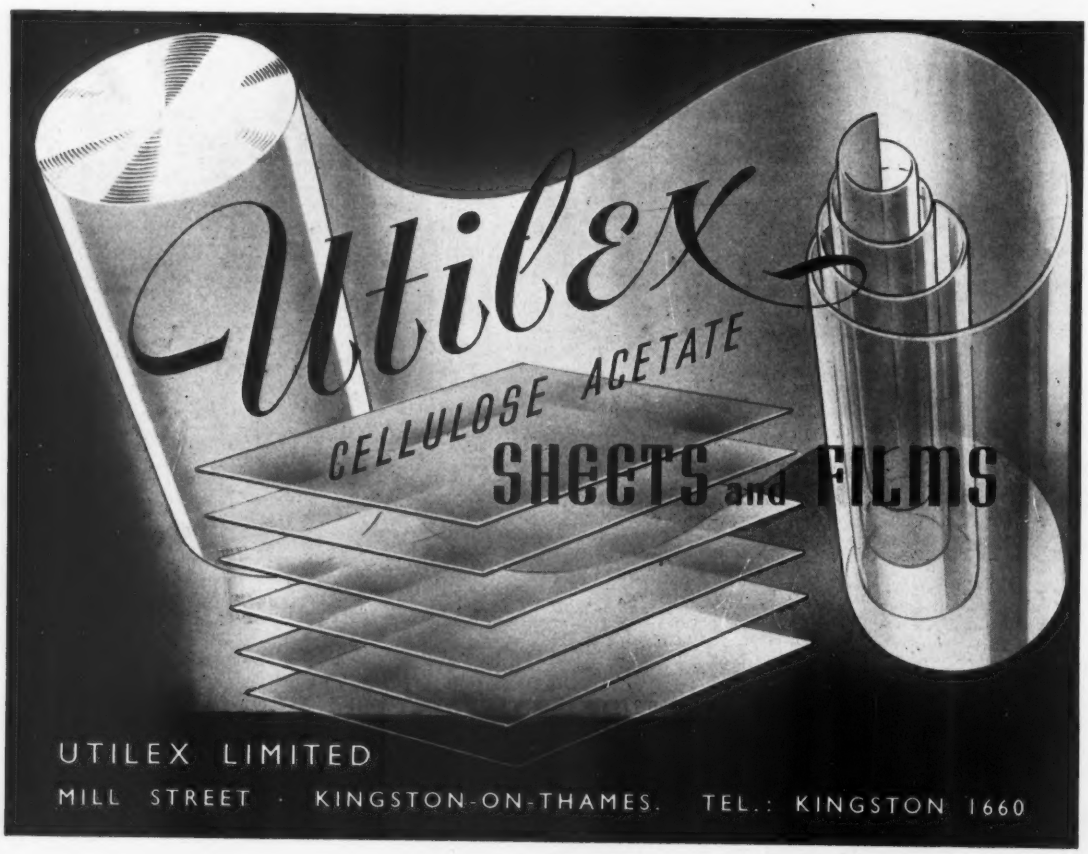

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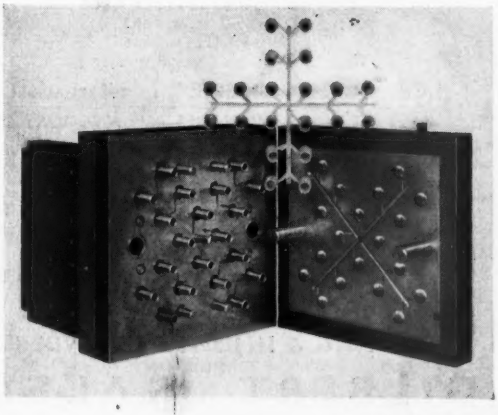

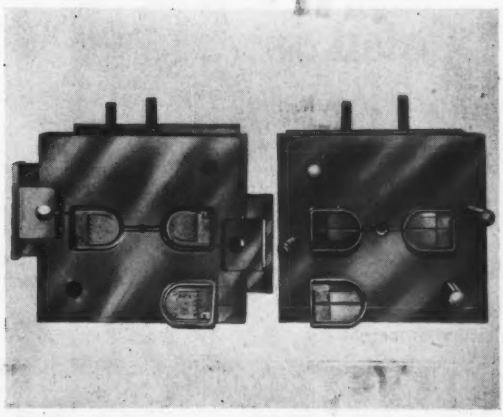

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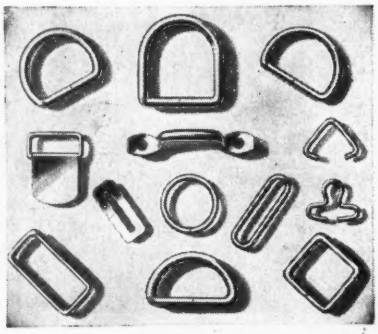

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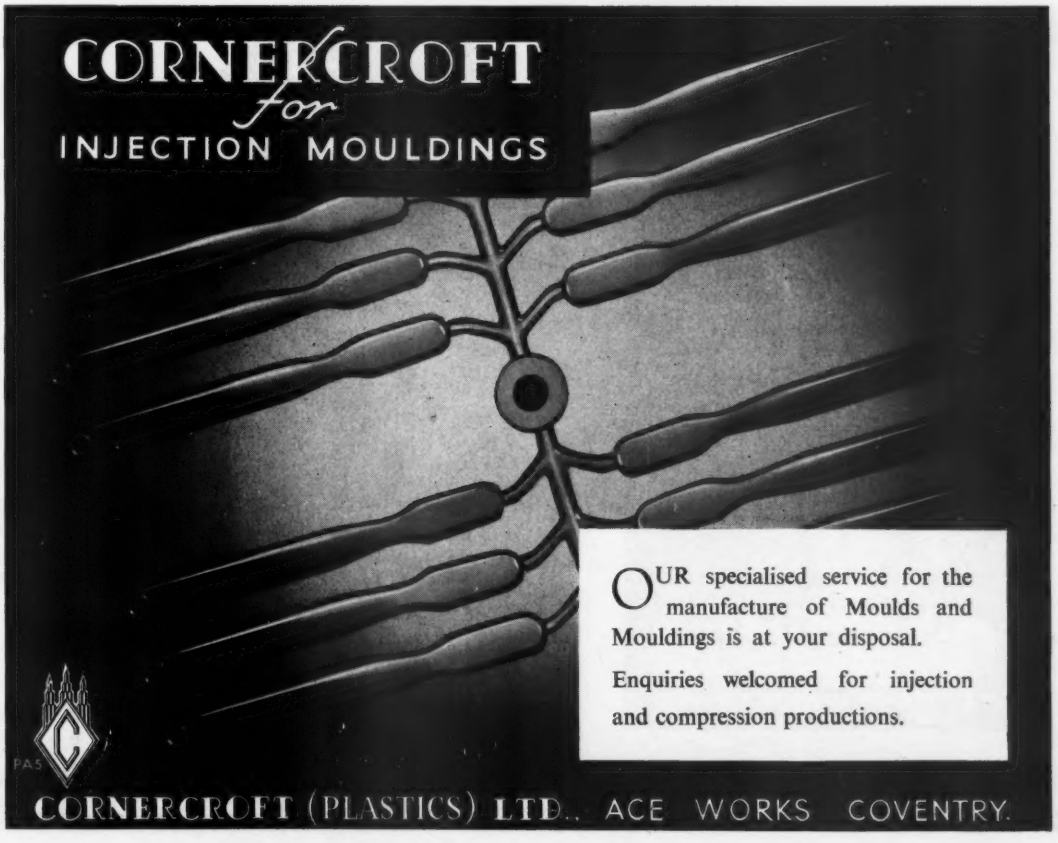
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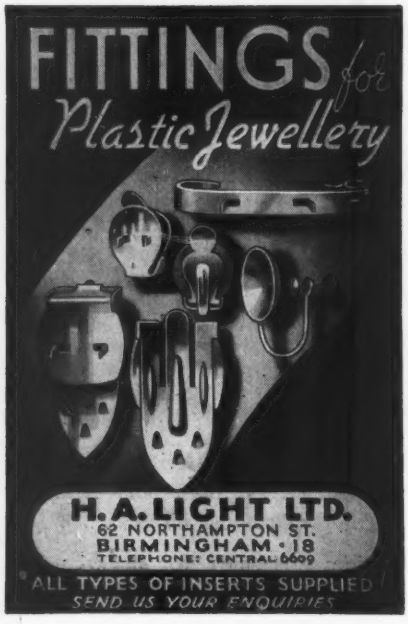

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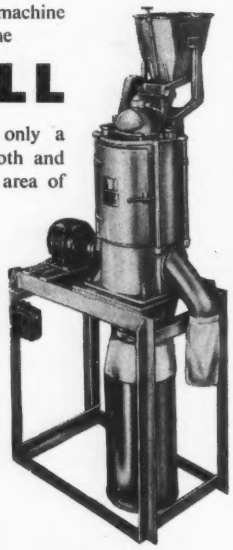

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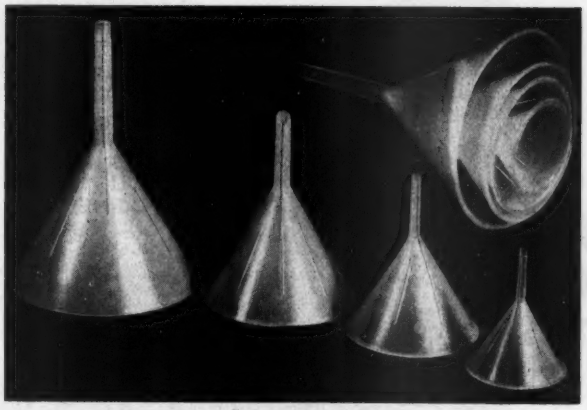

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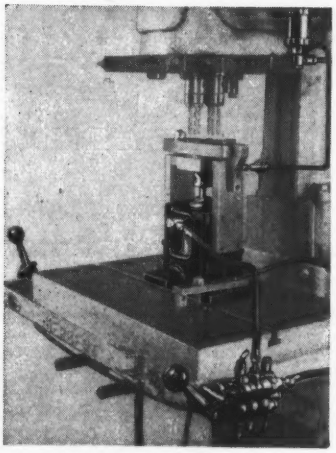

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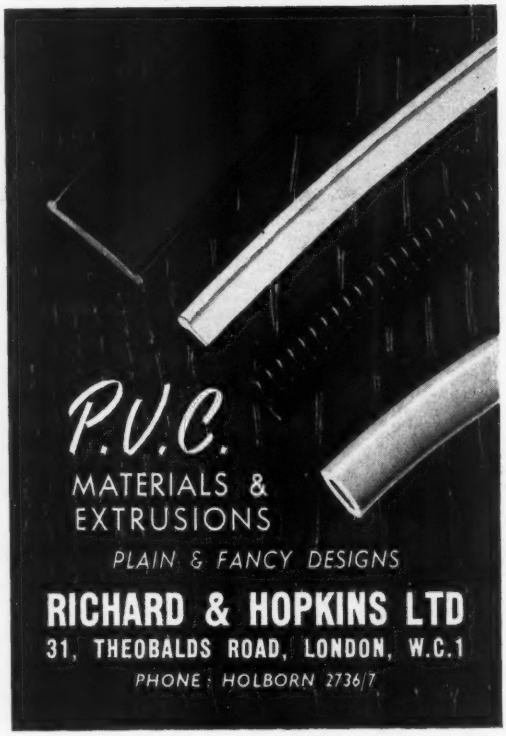

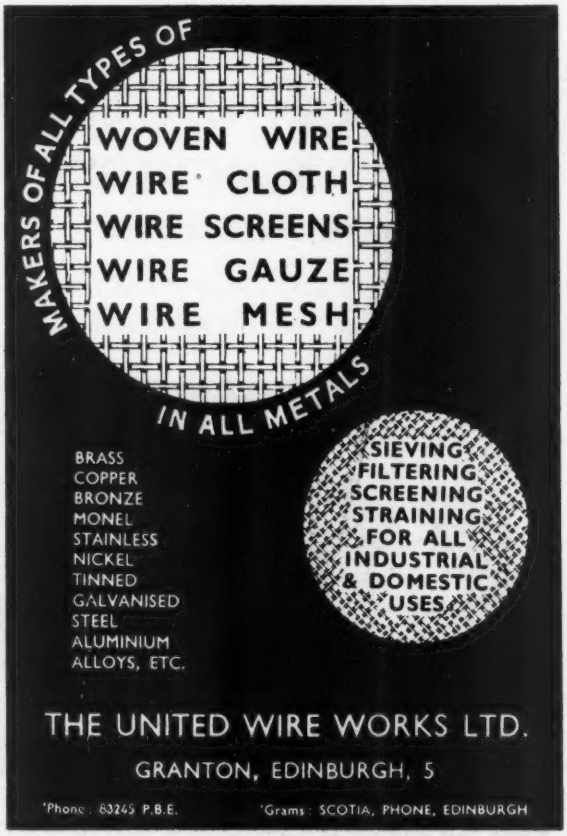

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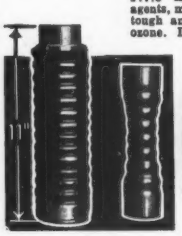

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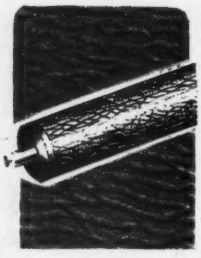

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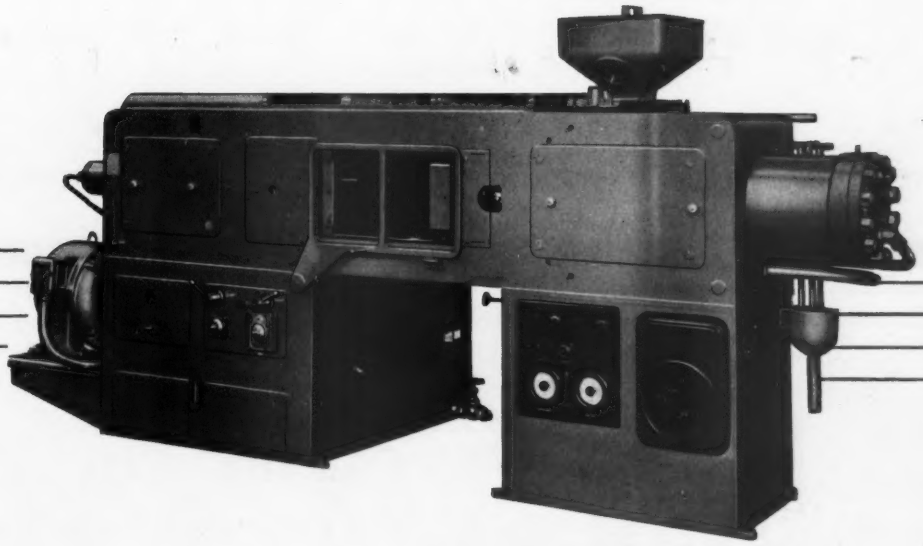

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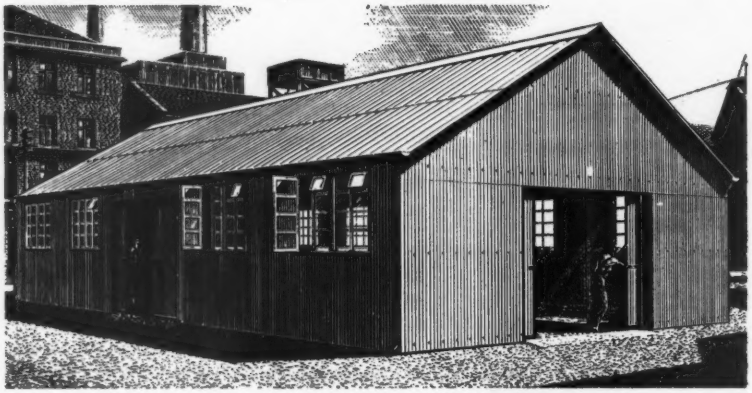

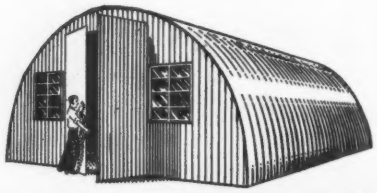

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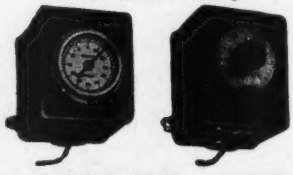

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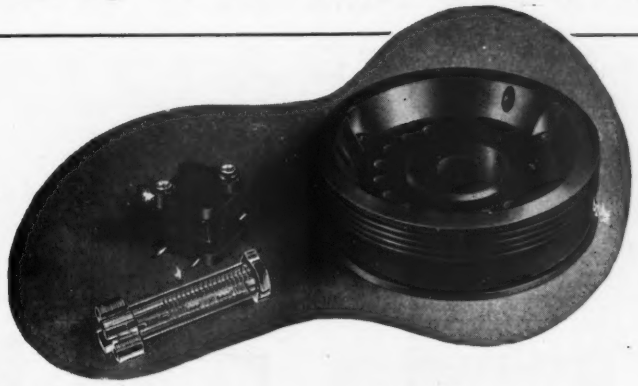

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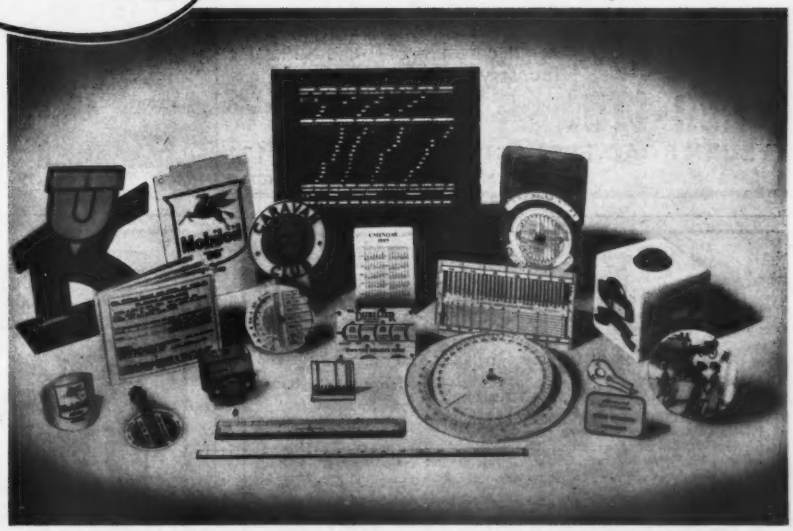

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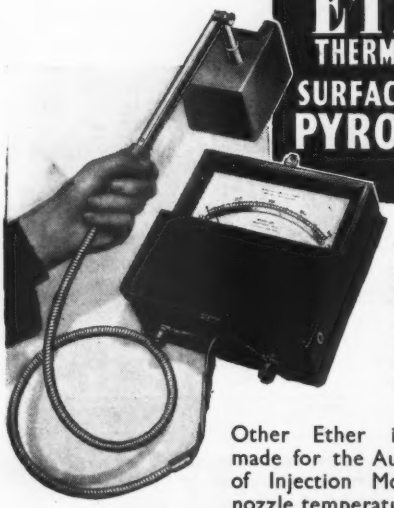

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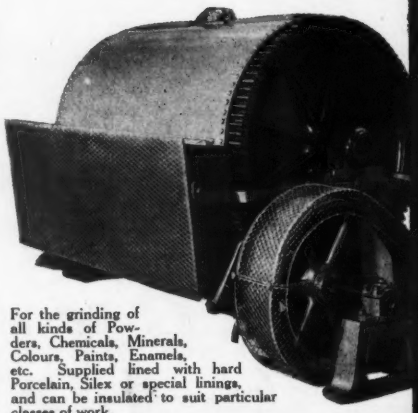

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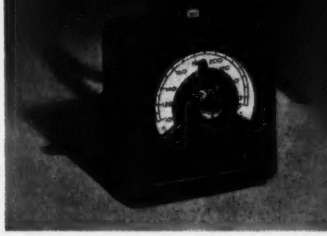

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WORKING FOREMAN required for Bakelite moulding factory, experienced with trade moulders on presses up to 250 tons on fast production preferred. Progressive position. State full details of past experience in date order and salary required. Box P4613, care of "Plastics." zzz-266

WANTED, Foreman for medium-sized injection moulding shop, London, toolmaker an advantage, drive and organizing ability essential, first-class man only. Box P4516, care of "Plastics." 147-19

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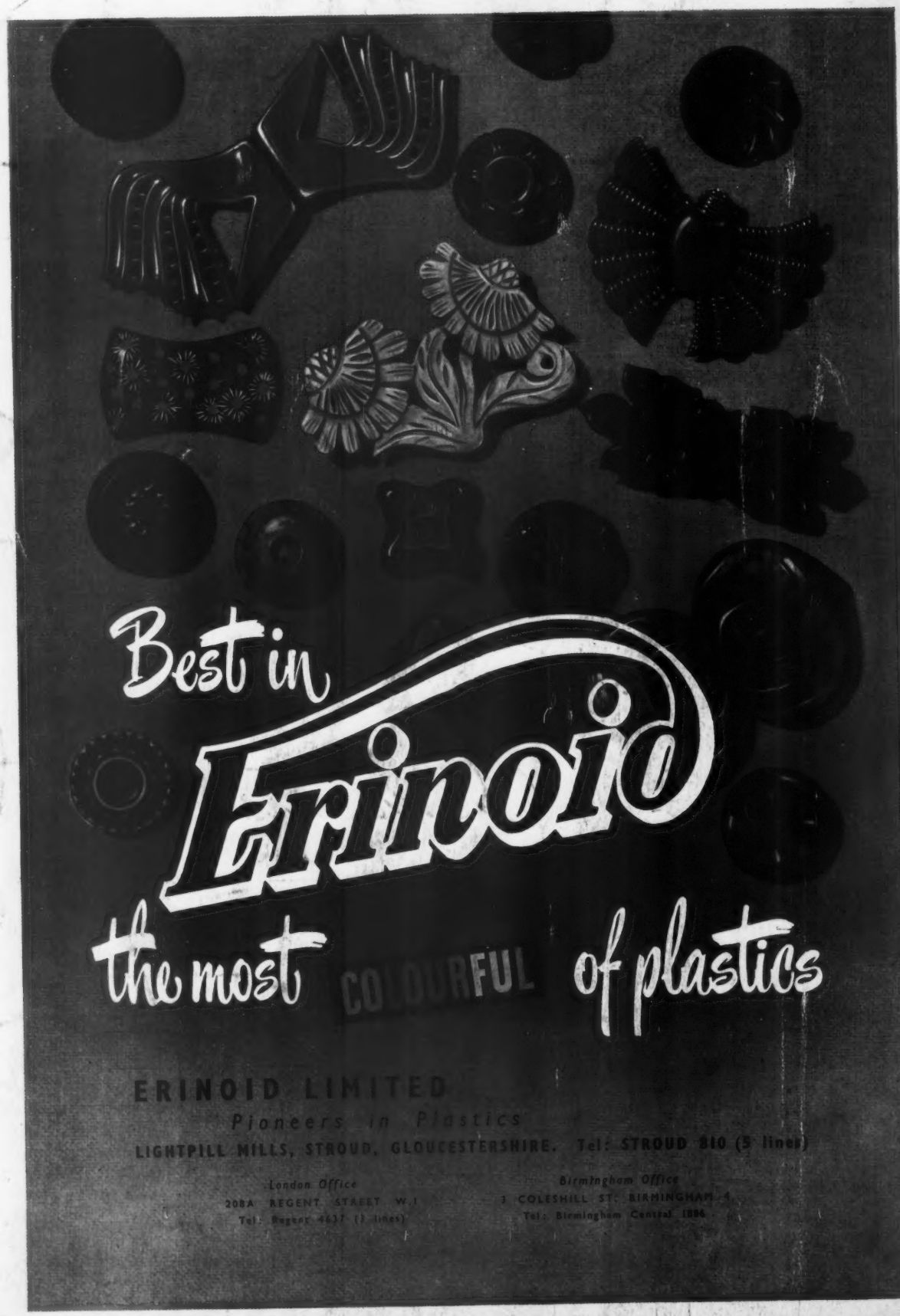
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